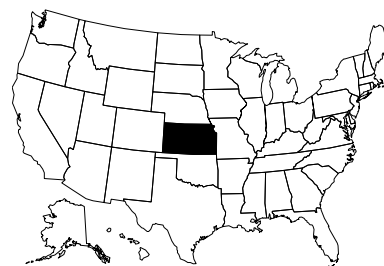


# KANSAS

## Contact Information

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KDHE Bureau of Environmental Field Services homepage:  
<http://www.kdhe.state.ks.us/befs/index.html>



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website: <http://www.kdwp.state.ks.us>

## Program Description

Kansas has maintained a stream biological monitoring program since 1972. Since 1980, the program has remained primarily unchanged. Program data are evaluated and incorporated in five year increments into the 305(b) report and 303(d) list. Data is used to determine aquatic life use support status in combination with chemical water quality data. Further details may be found in the program Quality Management Plan (see documentation below).

### Contemporary Program Objectives

The stream biological monitoring program endeavors to provide scientifically defensible information on the quality of flowing waters in Kansas through the analysis of aquatic macroinvertebrate communities. This information is intended for use in:

- (1) complying with the water quality monitoring and reporting requirements of 40 CFR 130.4 and sections 106(e)(1), 303(d) and 305(b) of the federal Clean Water Act;
- (2) evaluating waterbody compliance with the Kansas surface water quality standards (K.A.R. 28-16-28b *et seq.*);
- (3) identifying point and nonpoint sources of pollution contributing most significantly to water use impairments in streams;
- (4) documenting spatial and temporal trends in surface water quality resulting from changes in land use patterns, resource management practices, pollutant loadings, and climatological conditions;
- (5) developing scientifically defensible environmental standards, wastewater treatment plan permits, and waterbody/watershed pollution control plans; and
- (6) evaluating the efficacy of pollution control efforts and waterbody remediation/restoration initiatives implemented by the department and other agencies and organizations.

The Kansas Department of Health and Environment's (KDHE) Bureau of Environmental Field Services is responsible for macroinvertebrate data collection and analysis. The Bureau also analyzes fish community data that are collected by the Kansas Department of Wildlife and Parks (KDWP). KDHE is currently working with the Central Plains Center for BioAssessment (CPCB) at the University of Kansas, to develop both a systematic approach to the identification of reference sites and a regionally standardized approach to habitat assessment.

## Documentation and Further Information

*Division of Environment Quality Management Plan Part III: Stream Biological Monitoring Program Quality Assurance Management Plan*, December 2000: [http://www.kdhe.state.ks.us/environment/qmp\\_2000/download/SBMP\\_QAMP.pdf](http://www.kdhe.state.ks.us/environment/qmp_2000/download/SBMP_QAMP.pdf)

*2002 Kansas Water Quality Assessment (305(b) report)*, April 2002:  
[http://www.kdhe.state.ks.us/befs/305b\\_2002/ks305b2002f.pdf](http://www.kdhe.state.ks.us/befs/305b_2002/ks305b2002f.pdf)

*Guidance Document for Use Attainability Analyses*, December 2001: <http://www.kdhe.state.ks.us/befs/uaas/UAAGuidance.pdf>

Draft 2002 303(d) Methodology and List: <http://www.kdhe.state.ks.us/tmdl/303d.htm>

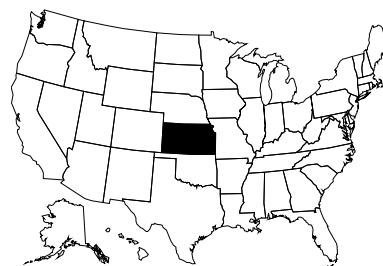
*Kansas State Water Quality Standards*: <http://www.kdhe.state.ks.us/water/index.html>

# KANSAS

## Contact Information

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 Phone 620/672-0710 ■ Fax 620/672-2972  
 email: [KristenM@wp.state.ks.us](mailto:KristenM@wp.state.ks.us)



## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input checked="" type="checkbox"/>	other: trend analysis
<b>Applicable monitoring designs*</b>	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>comprehensive use throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide ( <i>comprehensive use throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	rotating basin ( <i>comprehensive use throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	other: rotational sites, statewide ( <i>comprehensive use throughout jurisdiction</i> )

\*KDWP uses a combination of probabilistic design, rotating basin, and fixed sites; KDHE relies primarily on a targeted design, including fixed and rotational sites statewide.

## Stream Miles

<b>Total miles</b>	<b>134,338</b>
<i>(determined using RF3)</i>	
Total perennial miles	23,731
<b>Total miles assessed for biology*</b>	<b>23,731</b>
fully supporting for 305(b)	n/a
partially/non-supporting for 305(b)	n/a
listed for 303(d)	n/a
number of sites sampled	178 targeted over 22 years (KDHE); several hundred probabalistic (KDWP)
number of miles assessed per site	site specific

\*Because KDWP uses a probabilistic sampling design, it can be said that all 23,731 perennial stream miles in Kansas are being assessed for biology. KDHE is working with KDWP to incorporate the latter agency's findings into Kansas' 305(b) reports and 303(d) lists. Kansas' 2002 305(b) report is based on four years of ambient stream chemistry data (1998-2001) and only acute aquatic life use support application.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Class System (A,B,C)
<b>ALU designations in state water quality standards</b>	Three designations: special aquatic life use, expected aquatic life use, restricted aquatic life use
<b>Narrative Biocriteria in WQS</b>	Procedures used to support narrative biocriteria are located in the most recent 305(b) reports
<b>Numeric Biocriteria in WQS</b>	none (Numeric biocriteria have not been adopted into the state standards, but are nevertheless used for diagnostic purposes and in 305(b) assessments.)
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation) <input type="checkbox"/> watershed based management
<b>Uses of bioassessment/ biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Various point source upgrades and TMDL-related applications

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>44 total</b>
<b>Reference site determinations*</b>	<input type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input type="checkbox"/> regional (aggregate of sites) <input checked="" type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Reference site criteria</b>	<p>To date, sites have been selected on the basis of land cover and land use, known hydrological properties and channel characteristics, general absence of confined animal feeding operations, point sources and urban areas, and favorable water quality attributes (low levels of total suspended solids, biochemical oxygen demand, fecal coliform bacteria, total phosphorus, inorganic nitrogen, herbicides, and other contaminants). Rare taxa and historically occurring key species are mainly used for validation purposes.</p> <p>Reference sites, by definition, should also be minimally impacted by anthropogenic phenomena and approach the presettlement condition in terms of hydrology, water quality, available biological habitat, surrounding landscape and watershed attributes, and historically documented plant and animal communities.</p>
<b>Characterization of reference sites within a regional context</b>	<input checked="" type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input type="checkbox"/> gradient response <input type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input type="checkbox"/> stream type <input type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input checked="" type="checkbox"/> other: stream size
<b>Additional information</b>	<input type="checkbox"/> reference sites linked to ALU <input type="checkbox"/> reference sites/condition referenced in water quality standards <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

\*Currently working with the Central Plains Center for BioAssessment (CPCB) at the University of Kansas to develop a more systematic approach to the identification of reference sites.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (100 - 500 samples/year; single season, multiple sites - broad coverage; multiple seasons, select sites)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; single season, multiple sites - broad coverage by KDWP only)
	<input checked="" type="checkbox"/>	periphyton (100 - 500 samples/year; multiple seasons, multiple sites - broad coverage for watershed level)*
	<input checked="" type="checkbox"/>	other: phytoplankton
<b>Benthos</b>		
sampling gear		collect by hand, D-frame; 500 - 600 micron mesh
habitat selection		richest habitat, riffle/run, multihabitat, woody debris, random sampling by KDWP only
subsample size		entire sample, 100 count minimum
taxonomy		genus/species where practical
<b>Fish</b>		
sampling gear		seine, backpack electrofisher, pram unit (tote barge); 1/8" and 3/16" mesh
habitat selection		multihabitat
sample processing		length measurement, biomass – batch
subsample		batch (generally do not subsample)
taxonomy		species
<b>Periphyton*</b>		
sampling gear		<b>natural substrate:</b> suction device, bar clamp sample; <b>artificial substrate:</b> periphytometer
habitat selection		wadeable area within stream segment that is designated based on other sampled biota
sample processing		chlorophyll <i>a</i> / phaeophytin, taxonomic identification (limited use)
taxonomy		diatoms only
<b>Habitat assessments</b>		
		visual based (KDHE), quantitative measurements (KDWP); performed with bioassessments
<b>Quality assurance program elements</b>		
		standard operating procedures, quality assurance plan, periodic meetings/training for biologists, sorting and taxonomic proficiency checks, specimen archival, replicate sampling, field audits, and staff certification program

\*Periphyton sampling is a new venture for the Kansas Biological Survey and the Central Plains Center for BioAssessment. Whole stream respiration as well as net and gross production via the DO diel cycle method are also determined. Software has been built to support these calculations using large continuous data sets of several weeks to months.

## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>return single metrics</i> )
	<input type="checkbox"/>	disturbance gradients
	<input checked="" type="checkbox"/>	other: regressions, correlations, trends, and other statistical applications
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		cumulative distribution function
defining impairment in a multimetric index		Kansas returns single metrics but is exploring various indices.
<b>Evaluation of performance characteristics</b>  <i>Refer to Quality Management Plan for SOPs and further information.</i>	<input checked="" type="checkbox"/>	repeat sampling
	<input checked="" type="checkbox"/>	precision
	<input checked="" type="checkbox"/>	sensitivity
	<input checked="" type="checkbox"/>	bias
	<input checked="" type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		Lotus Notes, Excel
Retrieval and analysis		Minitab, spreadsheet graphics, ArcView, ArcGIS, GARP (pending)

# KENTUCKY

## Contact Information

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KY Division of Water homepage: <http://water.nr.state.ky.us/dow/dwhome.htm>



## Program Description

A 100 point scale multi-metric index is under development in order to give equal weight to the three assemblages collected (fish, macroinvertebrates and algae). KY Division of Water is also working in conjunction with USEPA/Cincinnati to develop boatable water collection methods for the larger rivers as a first phase of biocriteria and assessment methods for larger rivers. There is a long term goal of establishing response relationships between biological indicators and nutrients in wadeable and boatable waters in order to investigate the feasibility of establishing nutrient criteria in these waters.

The Division of Water has shifted to a watershed approach in assessing stream miles. At this time about two fifths of the stream miles assessed have been entered in the data base, and data from another two fifths are being inputted. The first round of watershed sampling (the last fifth) will be completed in summer 2002. Somewhere between 30,000 to 40,000 actual miles will have been assessed by the time this project is completed.

Probabilistic sampling is also being conducted in all major watersheds. When this is completed, KY Division of Water will be able to estimate the number of stream miles meeting and not meeting designated uses. KY Division of Water was able to carry out this expansion thanks to valuable partnerships with Universities and the Kentucky Department of Fish and Wildlife Resources. These data are used to assess use support for Kentucky's 305(b) Report and for listing streams on the 303(d) list. Biological data can override chemical data if they are contradictory. There is a strong belief that the biological data collected and the collection methods used paint a truer picture of use attainment than chemical data.

Another important application of increased biological knowledge of waters in Kentucky has been the development of biological endpoints for successful stream restoration projects undertaken as a result of environmental damage incidents.

## Documentation and Further Information

2000 Kentucky Report to Congress on Water Quality, 305(b) report:  
[http://water.nr.state.ky.us/wq/305b/2000/2000\\_305b.htm](http://water.nr.state.ky.us/wq/305b/2000/2000_305b.htm)

1998 303(d) List of Waters for Kentucky, June 1998: <http://water.nr.state.ky.us/303d/>

1998-1999 Monitoring Strategy: Kentucky River Basin Management Unit, March 2000:  
[http://www.uky.edu/WaterResources/Watershed/KRB\\_AR/PDF\\_Files/Monitoring%20Report.PDF](http://www.uky.edu/WaterResources/Watershed/KRB_AR/PDF_Files/Monitoring%20Report.PDF)

For a list and links to more references and documents, conduct a search on the *Kentucky Natural Resources and Environmental Protection Cabinet (NREPC)* publication site:  
<http://www.kyenvironment.org/nrepc/publications/publications.asp>

### *Kentucky Watershed Management Framework*

Other documents include Reference Reach Reports on Algae, Fish and Macroinvertebrates; Division of Water SOP manuals; Consultant reports; USFWS surveys; Kentucky State Nature Preserve Commission surveys; Kentucky Department of Fish and Wildlife Resources surveys; Federal Register notices on Federal T&E listings.

# KENTUCKY

## Contact Information

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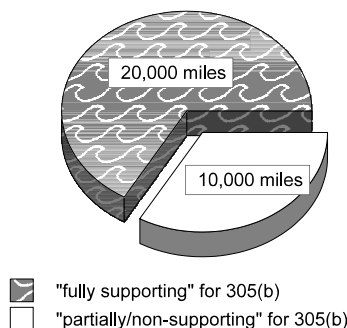
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
<b>Applicable monitoring designs</b>	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects only, specific river basins or watersheds, and comprehensive use throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide ( <i>specific river basins or watersheds</i> )
	<input checked="" type="checkbox"/>	rotating basin ( <i>specific river basins or watersheds</i> )
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b>	<b>89,431</b>
<i>(determined using the National Hydrography Database)</i>	
Total perennial miles	34,334
<b>Total miles assessed for biology*</b>	<b>~30,000</b>
fully supporting for 305(b)	~20,000
partially/non-supporting for 305(b)	~10,000
listed for 303(d)	7,500
number of sites sampled	1,750
number of miles assessed per site	—

## 30,000 Miles Assessed for Biology



\*Kentucky has shifted to a basin approach in assessing stream miles. At this time about 2/5ths of the stream miles assessed have been entered in the database, which translates to 10,200 actual miles assessed. There is also data from another 2/5ths that is presently being inputted into the database. The first round of watershed sampling (the last 1/5th) will be completed this summer. 30,000 to 40,000 actual miles will have been assessed upon completion. Probabilistic sampling is also being conducted in all major watersheds. The number of stream miles meeting and not meeting designated uses can be estimated when this is completed.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Warm water vs. Cold water
<b>ALU designations in state water quality standards</b>	Two designations - Warm water and Cold water
<b>Narrative Biocriteria in WQS</b>	Numeric procedures used to support narrative biocriteria referenced in KAR 5:030, and in Division publications and SOP manuals.
<b>Numeric Biocriteria in WQS</b>	none
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation) <input checked="" type="checkbox"/> watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Bioassessments have been used to delist streams from the 303(d) list.

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>140 total</b>
<b>Reference site determinations</b>	<input type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Reference site criteria</b>	Minimally impacted from point and nonpoint pollution, natural habitat with high forest density relative to other land uses. Other criteria listed in KY's reference reach report on fish communities. Also depends on ecoregion: habitat score - conductivity (region specific) - nutrients (in some cases).*
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input type="checkbox"/> gradient response <input type="checkbox"/> professional judgment <input checked="" type="checkbox"/> other: minimally impacted*
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input type="checkbox"/> stream type <input checked="" type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input type="checkbox"/> other:
<b>Additional information</b>	<input type="checkbox"/> reference sites linked to ALU <input checked="" type="checkbox"/> reference sites/condition referenced in water quality standards (found in 401 KAR 5:030 Section 1(1)(b)4) <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

\*KY tries to use minimally impacted reference sites whenever possible, but least disturbed sites are used to set targeted conditions when there are no minimally impacted sites in a subecoregion.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (<100 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	periphyton (<100 samples/year; single season, multiple sites - broad coverage)
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		D-frame, dipnet, kick net (1 meter), collect by hand; >800 micron mesh
habitat selection		multihabitat
subsample size		entire sample
taxonomy		combination - family, genus, species
<b>Fish</b>		
sampling gear		seine, backpack electrofisher, boat electrofisher, pram unit (tote barge), gill nets, trammel nets; 3/16" mesh
habitat selection		multihabitat
sample processing		none
subsample		none
taxonomy		species
<b>Periphyton</b>		
sampling gear		<b>natural substrate:</b> suction device, brushing/scraping device (razor, toothbrush, etc.), collect by hand; <b>artificial substrate:</b> periphytometer (in non-wadeable waters)
habitat selection		multihabitat
sample processing		taxonomic identification
taxonomy		species
<b>Habitat assessments</b>		
		visual based; performed with bioassessments
<b>Quality assurance program elements</b>		
		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival

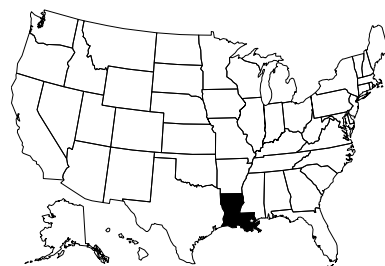
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		95 <sup>th</sup> percentile of all sites-standard based on a 100 unit scale
defining impairment in a multimetric index		25 <sup>th</sup> percentile of reference population (100 point scale multi-metric index is under development)
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>annual variability</i> )
	<input checked="" type="checkbox"/>	precision ( <i>repeatability</i> )
	<input checked="" type="checkbox"/>	sensitivity ( <i>Box-Whisker distributions</i> )
	<input type="checkbox"/>	bias
	<input checked="" type="checkbox"/>	accuracy (% test sites - nonreference, impaired - validation)
<b>Biological data</b>		
Storage		EDAS
Retrieval and analysis		SAS, Systat, EDAS, Excel, MVSP (Multi-Variate Statistical Package), Statgraphics

# LOUISIANA

## Contact Information

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LDEQ Planning homepage: <http://www.deg.state.la.us/planning/>



## Program Description

In Louisiana, bioassessments have been used principally to characterize and delineate reference streams. Bioassessments have also been used for assessing the biological conditions of waterbodies being evaluated for site-specific standards development and use attainability analysis. Bacterial monitoring is conducted for swimming use assessment, Periodic toxicity testing is also conducted. In a very special case, biocriteria were developed for specific wetlands to receive treated disinfected wastewater for wetland restoration.

Further development of bioassessment procedures is dependent on the legal responsibilities and outcome of a consent decree on the Louisiana TMDL program. Any additional development will have to be compatible with TMDL deadlines and deliverables. Since Louisiana does not have biocriteria, there is not a great need for LDEQ to conduct large scale bioassessments to determine criteria attainment. When the concept of biocriteria is adequately thought out and developed for use in state permitting and TMDL programs, then LDEQ will have a larger, more inclusive, bioassessment program. The use and revision of chemical/physical criteria, standards, and assessment procedures are considered the present priority.

The Louisiana Department of Wildlife and Fisheries (LDWF) monitors fishery resources on large rivers and in coastal waters of the state for management purposes and for establishing commercial and recreational regulations on harvest. However, these assessments are not conducted to determine compliance with the Clean Water Act. Environmental agencies are increasing collaboration and coordination with LDWF and are hoping to begin combining monitoring efforts and sharing biological data at a future date.

## Documentation and Further Information

*State of Louisiana Water Quality Management Plan Water Quality Inventory Section 305(b) 2000:*  
<http://www.deg.state.la.us/planning/305b/2000/index.htm>

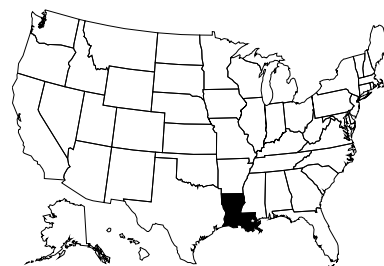
Dewalt, R. E. 1997. *Fish and macroinvertebrate taxonomic richness, habitat quality, and in-situ water chemistry of ecoregion reference streams in the Western Gulf Coastal Plains and Terrace Upland Ecoregions of Southern Louisiana*. Prepared for the Louisiana Department of Environmental Quality. Baton Rouge, LA. 72 pages.

Dewalt R. E. 1995. *Biological communities of reference streams in the South Central Plains and Upper Mississippi Alluvial Plains ecoregions of Louisiana*. Prepared for the Louisiana Department of Environmental Quality. Baton Rouge, LA. 85 pages.

# LOUISIANA

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 email: [dugan\\_s@deq.state.la.us](mailto:dugan_s@deq.state.la.us)



## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input type="checkbox"/>	nonpoint source assessments
	<input type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input type="checkbox"/>	TMDL assessment and monitoring
	<input checked="" type="checkbox"/>	other: ecoregion reference stream delineation, public education, bacteria assessment for swimming use, occasional toxicity testing, wetlands criteria
<b>Applicable monitoring designs</b>	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects and specific river basins or watersheds</i> )
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input type="checkbox"/>	rotating basin
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b>	<b>66,294</b>
<i>(State based estimation)</i>	
Total perennial miles	—
<b>Total miles assessed for biology*</b>	—
fully supporting for 305(b)	n/a
partially/non-supporting for 305(b)	n/a
listed for 303(d)	n/a
number of sites sampled	—
number of miles assessed per site	—

\*Bioassessments are not used for 305(b)/303(d) reporting purposes or biocriteria development. Louisiana's 2000 305(b) report listed 7,228 total river and stream miles assessed using chemical/physical criteria for fish and wildlife propagation and limited aquatic life/wildlife designated uses: 1,118 miles fully supporting and 6,110 miles partially/non-supporting for 305(b).

## Aquatic Life Use (ALU) Designations and Decision-Making\*

<b>ALU designation basis</b>	Class System (A,B,C)	
<b>ALU designations in state water quality standards</b>	Two designations: 1) Fish and wildlife propagation, 2) Limited aquatic/wildlife (a subcategory of fish and wildlife propagation)	
<b>Narrative Biocriteria in WQS</b>	A qualitative and/or narrative scale of condition that supports narrative biocriteria decisions is found in Louisiana's water quality standards, LAC 33:IX.1111.C and 1113.B.12	
<b>Numeric Biocriteria in WQS</b>	none	
<b>Uses of bioassessment data in integrated assessments with other environmental data</b> (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Bioassessments have been used to delineate reference streams, which in turn have been used in management decisions for setting DO criteria across ecoregions.	

\*Aquatic life use is assessed using chemical/physical numerical and general criteria. Louisiana does have general (narrative) criteria for biological and aquatic community integrity.

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>16 total</b>	
<b>Reference site determinations</b>	<input checked="" type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Reference site criteria</b>	Least impacted Wadeable streams, determined using best professional judgment ("common sense criteria")	
<b>Characterization of reference sites within a regional context</b>	<input checked="" type="checkbox"/>	historical conditions ( <i>when information is available</i> )
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: Wadeable streams
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
<b>Additional information</b>	<input checked="" type="checkbox"/>	reference sites linked to ALU
	<input checked="" type="checkbox"/>	reference sites/condition referenced in water quality standards ( <i>found in LAC 33:IX.1113.B.12</i> )
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (<100 samples/year; multiple seasons, multiple sites - broad coverage for watershed level)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; multiple seasons, multiple sites - broad coverage for watershed level)
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		collect by hand, dipnet, kick net (1 meter); 500-600 micron mesh
habitat selection		multihabitat, woody debris, richest habitat
subsample size		300 count
taxonomy		family and species
<b>Fish</b>		
sampling gear		backpack and boat electrofishers, Rotenone, seine; 1/8" and 1/4" mesh
habitat selection		multihabitat
sample processing		length measurement and anomalies
subsample		none
taxonomy		species
<b>Habitat assessments</b>		
		visual based; performed with bioassessments (habitat reference conditions found in WQS, LAC 33:IX.1113.B.12.)
<b>Quality assurance program elements</b>		
		standard operating procedures and quality assurance plan

## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input type="checkbox"/>	disturbance gradients
	<input checked="" type="checkbox"/>	other: nonparametric analysis
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		cumulative distribution function, North Carolina Biotic Index (NCBI), EPT, fish richness metrics (USEPA 1989)
defining impairment in a multimetric index		cumulative distribution function, NCBI, EPT, fish richness metrics (USEPA 1989)*
<b>Evaluation of performance characteristics</b>		
<i>Not currently evaluated</i>	<input type="checkbox"/>	repeat sampling
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		spreadsheets and paper files
Retrieval and analysis		SAS and Excel

\*LDEQ has used biological indices and matrices for evaluating Wadeable streams in several ecoregions and for determining appropriate reference sites. These indices and matrices have not been adopted into the water quality standards and are not used to assess impairment for 305(b) or regulatory purposes.

# MAINE

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MDEP Biomonitoring Program website: <http://www.state.me.us/dep/blwq/biohompg.htm>  
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## Program Description

Biological monitoring is a primary method used by the State of Maine to assess water quality. The Biological Monitoring Program is one of five Sections within the Division of Environmental Assessment. All field, analytical and statistical methods, including the resultant numeric biocriteria have been designed, developed and tested by the MDEP Biomonitoring Program staff and a consulting biostatistician (Dr. Francis Drummond, University of Maine, Orono, Maine). Water quality standards in current use in Maine, including tiered aquatic life uses and statutory definitions of biological terms, were drafted by the Biomonitoring Program and other staff of the Division of Environmental Assessment.

The State of Maine began the process of biological criteria development by incorporating explicit narrative standards for aquatic life uses in the state water quality classification law. Each of three classes, ranging from "natural" (Class A) to minimum state standards (Class C), contains specific language that defines the allowable biological response, taking into consideration other designated uses, and expectations of community response to human activities allowed in that class. The benthic macroinvertebrate community is assessed to determine attainment of standards.

Maine's numeric biological criteria rely on a three stage decision process. The first stage is a linear discriminant model, utilizing nine metrics to assign an initial classification probability for an unknown site. The second stage linear discriminant model uses 17 additional metrics and indicator taxa, along with probabilities derived in the first stage model, to compute final probabilities of group membership. The output is expressed as a probability of group membership for each of the four water quality classes. The highest class attained, with at least 60% probability, is used as the final model outcome. The third stage uses expert biologist's judgement to make a final decision about attainment, based on the outcome of the linear discriminant analysis, with adjustments for any known sampling errors, unexplained community structure anomalies or atypical conditions surrounding the sampling event.

The regulatory authority for the Department's numeric biological criteria is derived from the tiered aquatic life use designations that are explicitly defined in the water quality standards law (MRSA Title 38 Article 4-A § 464-465). The Department has draft rules in support of the numeric biocriteria protocol and is expected to go to rule-making as soon as a needed electronic database upgrade is completed. The Biological Monitoring Program provides water quality information for a wide array of programs and initiatives including:

- evaluation of water quality classification attainment and 303(d) listing;
- evaluation of impacts downstream of discharges;
- general, long-term ambient monitoring and trend assessment;
- evaluation of the effects of management activities
- evaluation of the effects of nonpoint source impacts;
- evaluation of impacts from diffuse toxic contamination through the Surface Water Ambient Toxics Program (MDEP 1993)
- evaluation of the impacts of hydropower activities in fulfillment of requirements for the Clean Water Act SEC. 401 water quality certification process.

In addition, the Program is refining methods and criteria to better assess aquatic biological impacts of poor land use practices on stream and wetland systems.

MDEP is funded to do a pilot project using the EPA Stressor Identification protocol applied to an intensively surveyed 303(d) listed urban watershed. To facilitate the development of TMDLs, findings from the SI procedure will be used to better target the assessment approach for a set of five other similarly impacted urban streams.

## Documentation and Further Information

*State of Maine 305(b) Report, Summer 2000*

*Biomonitoring Retrospective: Fifteen Year Summary for Maine Rivers and Streams, December 1999:*  
<http://www.state.me.us/dep/blwq/docmonitoring/biological/biorep2000.htm>

S.P. Davies & L. Tsomides, (1997) "*Methods for Biological Sampling and Analysis of Maine's Inland Waters*", MDEP, revised June 1997: <http://www.state.me.us/dep/blwq/docmonitoring/finlmeth.pdf>

Relevant biomonitoring materials can be accessed online: <http://www.state.me.us/dep/blwq/>

# MAINE

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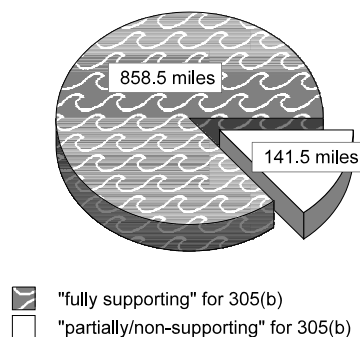
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	✓	problem identification (screening)
	✓	nonpoint source assessments
	✓	monitoring the effectiveness of BMPs
	✓	ALU determinations/ambient monitoring
	✓	promulgated into state water quality standards as biocriteria
	✓	support of antidegradation
	✓	evaluation of discharge permit conditions
	✓	TMDL assessment and monitoring
	✓	other: hydropower dam licensing, uncontrolled hazardous waste site monitoring
<b>Applicable monitoring designs</b>	✓	targeted (i.e., sites selected for specific purpose) ( <i>special projects only</i> )
	✓	fixed station (i.e., water quality monitoring stations) ( <i>specific river basins or watersheds</i> )
		probabilistic by stream order/catchment area
		probabilistic by ecoregion, or statewide
	✓	rotating basin ( <i>5 yr rotation, specific river basins or watersheds</i> )
	✓	other: hydropower dam licensing, uncontrolled hazardous waste site monitoring

## Stream Miles

<b>Total miles</b>	<b>31,672</b>
<i>(determined using state based local GIS coverage)</i>	
Total perennial miles	23,879
<b>Total miles assessed for biology</b>	<b>1,000*</b>
fully supporting for 305(b)	858.5
partially/non-supporting for 305(b)	141.5
listed for 303(d)	141.5
number of sites sampled ( <i>on an annual basis</i> )	40
number of miles assessed per site	~5

1,000 Miles Assessed for Biology



\*These miles are based on the last five years of monitoring. Stream and river miles are combined, with streams accounting for roughly 80% of the total miles assessed. For program-wide estimation purposes, miles are estimated assuming that each monitored station assesses about 5 miles of river or stream, though this number does vary. The last few years, up to 55 sites have been sampled, but 40 is the average number.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Class system (AA, A, B, C)
<b>ALU designations in state water quality standards*</b>	Four designations based on a gradient of biological condition: AA- "as naturally occurs", natural flow regime; A- "as naturally occurs", hydro allowed; B- "no detrimental change"; C- "maintain structure and function, support for salmonids"
<b>Narrative Biocriteria in WQS</b>	Procedures used to support narrative biocriteria located in MDEP WQS.
<b>Numeric Biocriteria in WQS</b>	under development – Draft numeric biocriteria rule in internal agency review, due for promulgation in 2002. (A probabilistic model - linear discriminant analysis - designed using expert judgment and statistical analysis is currently used to determine attainment of conditions described in aquatic life standards. Numeric biocriteria have been used to implement agency policy since 1990.)
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation) <input checked="" type="checkbox"/> watershed based management ( <i>pertains to "small" watersheds</i> )
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Many examples of this have been documented in case studies provided in "Biomonitoring Retrospective: Fifteen year summary for Maine rivers and streams" available in .pdf on website: <a href="http://www.state.me.us/dep/blwq/docmonitoring/biological/biorep2000.htm">http://www.state.me.us/dep/blwq/docmonitoring/biological/biorep2000.htm</a>

\*Tiered aquatic life uses in Maine Water Quality standards are consistent with the condition gradient describing other applicable WQ standards (dissolved oxygen, bacteria, toxics) for each class.

## Reference Site/Condition Development

<b>Number of reference sites</b>	370 total
<b>Reference site determinations</b>	<input type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input checked="" type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Reference site criteria</b>	Minimally disturbed reference site standards are defined by the following criteria – Based on ArcView GIS coverages; by percent of watershed upstream of the sampled station: >90% forested; <5% active logging; <1% cropland, residential or urban.
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input checked="" type="checkbox"/> gradient response <input checked="" type="checkbox"/> professional judgment <input checked="" type="checkbox"/> other: minimally disturbed**
<b>Stream stratification within regional reference conditions</b>	<input type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input type="checkbox"/> stream type <input checked="" type="checkbox"/> multivariate grouping ( <i>4 multivariate groups</i> ) <input type="checkbox"/> jurisdictional (i.e., statewide) <input type="checkbox"/> other:
<b>Additional information</b>	<input checked="" type="checkbox"/> reference sites linked to ALU <input checked="" type="checkbox"/> reference sites/condition referenced in water quality standards ( <i>State of Maine, 1985. Maine Laws Ch. 698 §15 - in part. An Act to Amend the Classification System for Maine Waters</i> ) <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

\*\*Minimally disturbed characterization is one component of established reference conditions; they are also divided into different classes and groups with different biological attributes. Maine has a range of streams, from pristine to severely degraded.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos ( <i>100-500 samples/year; single season, multiple sites - watershed level and broad coverage</i> )
	<input type="checkbox"/>	fish
	<input checked="" type="checkbox"/>	periphyton ( <i>&lt;100 samples/year; single season, multiple sites - broad coverage</i> )
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		rock baskets (500-600 micron mesh)
habitat selection		riffle/run (cobble), artificial substrate
subsample size		entire sample ( <i>if &gt;500 organisms, subsamples are taken proportionately at 25% of sample, then adjusted back to whole sample counts</i> )
taxonomy		genus, species ( <i>identified to lowest possible level; adjusted to genus in database</i> )
<b>Periphyton</b>		
sampling gear		<b>natural substrate:</b> brushing/scraping device (razor, toothbrush, etc.) <b>artificial substrate:</b> periphytometer
habitat selection		open canopy in riffle/run
sample processing		chlorophyll <i>a</i> / phaeophytin; biomass; taxonomic identification
taxonomy		all algae; genus level; species level
<b>Habitat assessments</b>		visual based; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan, periodic meetings, training for biologists, sorting proficiency checks, taxonomic proficiency checks, specimen archive

## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>multiple computed metrics are used as input variables in probabilistic model</i> )
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multivariate thresholds</b>		
defining impairment in a multivariate index		Probabilistic model using <i>a priori</i> sites defined by expert judgement
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>long-term annual monitoring sites</i> )
	<input checked="" type="checkbox"/>	precision ( <i>percent accuracy compared to a priori class</i> )
	<input type="checkbox"/>	sensitivity
	<input checked="" type="checkbox"/>	bias ( <i>in relation to stream size, latitude/longitude, velocity, eco-region</i> )
	<input checked="" type="checkbox"/>	accuracy ( <i>percent accuracy compared to a priori class; a priori reference sites compared to land use - selected reference sites</i> )
<b>Biological data</b>		
Storage		STORET; Oracle/Visual Basic relational database (with linkage to ARCINFO spatial database with point coverage for all monitoring stations)
Retrieval and analysis		Core linear discriminant models statistical routines are run and reported from within the Oracle database; spatial analysis in ArcView and ARCINFO; routine queries run in MS Access, Systat or Excel

# MARYLAND

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MD DNR Maryland Streams homepage: <http://www.dnr.state.md.us/streams/index.html>



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## Program Description

The Maryland Biological Stream Survey (MBSS) is a program of the Maryland Department of Natural Resources (MD DNR) and is intended to provide statistically unbiased estimates of the condition of first through third-order (wadeable) non-tidal streams and rivers of Maryland on a local (e.g., drainage basin or county) as well as a statewide scale. The survey is based on a probabilistic stream sampling approach where random selections are made from all streams in the state that can physically be sampled. The approach supports statistically valid population estimation of variables of interest (e.g., largemouth bass densities, miles of streams with degraded physical habitat, miles of streams with poor Index of Biotic Integrity scores, etc.). When repeated, the Survey will also provide a basis for assessing future changes in ecological condition of flowing waters of the state. At present, plans are to repeat the Survey at regular intervals and expand the approach to larger streams and tidal creeks.

Benthic macroinvertebrates and water quality samples are collected during the spring index period from March through early May, while fish, herpetofauna, *in situ* stream chemistry, and physical habitat sampling are conducted during the low flow period in the summer, from June through September.

Data collected from each sample site are used to develop statewide and basin-specific estimates of totals, means (or averages), proportions, and percentiles for the parameters of interest. The amount of variability (or margin of error) associated with any estimate of a total, mean, proportion, or percentile is determined by calculating a standard error, a statistic that measures the reliability of an estimate. A standard error also provides a statistical basis for deciding if the observed changes in any parameter of interest over time or space are significantly different or simply due to chance alone.

## Documentation and Further Information

2000 Maryland Section 305(b) Water Quality Report, with Appendix E, Assessment Methodology:  
[http://dnrweb.dnr.state.md.us/download/bays/MD2000\\_305b.pdf](http://dnrweb.dnr.state.md.us/download/bays/MD2000_305b.pdf)

DRAFT 2002 Integrated 303(d) List: [http://www.mde.state.md.us/tmdl/2002\\_303dlist/index.html](http://www.mde.state.md.us/tmdl/2002_303dlist/index.html)

From the Mountains to the Sea: The State of Maryland's Freshwater Streams, December 1999:  
<http://www.dnr.state.md.us/streams/pubs/md-streams.pdf>

Maryland Biological Stream Survey (MBSS) Sampling Manual, February 2000:  
[http://www.dnr.state.md.us/streams/pubs/2000samp\\_manual.pdf](http://www.dnr.state.md.us/streams/pubs/2000samp_manual.pdf)

MBSS Laboratory Methods for Benthic Macroinvertebrate Processing and Taxonomy, November 2000:  
[http://www.dnr.state.md.us/streams/pubs/ea00-6\\_lab\\_man.pdf](http://www.dnr.state.md.us/streams/pubs/ea00-6_lab_man.pdf)

Refinement and Validation of a Fish Index of Biotic Integrity (IBI) for Maryland Streams, October 2000:  
[http://www.dnr.state.md.us/streams/pubs/ea00-2\\_fibi.pdf](http://www.dnr.state.md.us/streams/pubs/ea00-2_fibi.pdf)

Development of a Benthic Index of Biological Integrity for Maryland Streams, December 1998:  
[http://www.dnr.state.md.us/streams/pubs/1998\\_Benthic%20IBI.pdf](http://www.dnr.state.md.us/streams/pubs/1998_Benthic%20IBI.pdf)

For more documents and publications, go to: [http://www.dnr.state.md.us/streams/mbss/mbss\\_pubs.html](http://www.dnr.state.md.us/streams/mbss/mbss_pubs.html) or  
[http://www.dnr.state.md.us/streams/pubs/pub\\_list.html](http://www.dnr.state.md.us/streams/pubs/pub_list.html)

# MARYLAND

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## Programmatic Elements

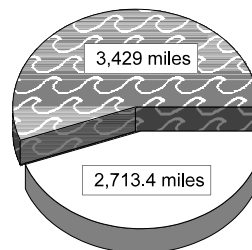
<b>Uses of bioassessment within overall water quality program</b>	✓	problem identification (screening)
	✓	nonpoint source assessments
	✓	monitoring the effectiveness of BMPs ( <i>LIMITED</i> )
	✓	ALU determinations/ambient monitoring ( <i>LIMITED</i> )
	UD	promulgated into state water quality standards as biocriteria ( <i>through MDE</i> )
	✓	support of antidegradation
	✓	evaluation of discharge permit conditions ( <i>LIMITED</i> )
	✓	TMDL assessment and monitoring ( <i>MDE using MBSS data</i> )
	✓	other: target restoration costs and locations; areas for preservation; track trends in stream conditions; identify relationships between stressors and biota; predict future conditions based on land use changes
<b>Applicable monitoring designs*</b>	✓	targeted ( <i>small portion - special projects and specific river basins or watersheds</i> )
	✓	fixed station (i.e., water quality monitoring stations) ( <i>sentinel site network, best of the best streams in the state, comprehensive use throughout jurisdiction</i> )
	✓	probabilistic by stream order/catchment area ( <i>comprehensive use throughout jurisdiction</i> )
	✓	probabilistic by ecoregion, or statewide ( <i>comprehensive use throughout jurisdiction</i> )
	✓	rotating basin ( <i>comprehensive use throughout jurisdiction</i> )
		other:



\*The largest portion of sampling effort is for probabilistic sampling with watershed as primary strata.

## Stream Miles

<b>Total miles</b>	<b>17,000</b>
<i>(determined using National Hydrography Database)</i>	
Total perennial miles	12,343
<b>Total miles assessed for biology**</b>	<b>6,142</b>
fully supporting for 305(b)	3,429.0
partially/non-supporting for 305(b)	2,713.4
listed for 303(d)**	178 actual listings
number of sites sampled ( <i>from 1995-1997</i> )	1,000
number of miles assessed per site	—

## 6,142 Miles Assessed for Biology



-  "fully supporting" for 305(b)
-  "partially/non-supporting" for 305(b)

\*\*The miles listed above were extracted from Maryland's 2000 305(b) Report, which stated, "The assessment of non-tidal rivers and streams is based on monitoring data, including ambient water quality monitoring programs and other water quality data collected by [various agencies and programs]." The above miles are categorized as "monitored" in the 2000 305(b). However, the MBSS method only applies to *wadeable* nontidal streams, thus some portion of the total assessed stream and river miles listed above were not assessed using this method. The 178 sites listed for 303(d) were pulled from the DRAFT 2002 303(d) Report. These miles do not include streams larger than 4<sup>th</sup> order or with tidal flow.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Single Aquatic Life Use, Fishery Based Uses, Warm Water vs. Cold Water	
<b>ALU designations in state water quality standards</b>	Seven uses: I: support of fish & aquatic life and recreation; I-P: adds drinking water supply to Use I; II: shellfish harvesting; III: natural trout; III-P: adds drinking water supply; IV: recreational trout (put and take); IV-P: adds drinking water.	
<b>Narrative Biocriteria in WQS</b>	Narrative regulations and formal/informal numeric procedures specifically addressing biocriteria applications are under development.	
<b>Numeric Biocriteria in WQS</b>	none - documented quantitative method applied	
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges ( <i>RARELY</i> )
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Threatened and Endangered species listings are being revised based on MBSS fish population data; cost estimates for habitat restoration in MD streams are being finalized in support of Chesapeake Bay 2000 Agreement action items; MBSS data integral to developing restoration priority ranking for MD watersheds; also used by The Nature Conservancy to develop highest priority watersheds for land acquisition and other preservation activities	

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>152 total</b>	
<b>Reference site determinations</b>	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: use combination of <i>a priori</i> physical and chemical criteria applied to randomly selected sites - these represent the best remaining sites in Maryland
<b>Reference site criteria</b>	Must meet <i>a priori</i> chemical and physical criteria (criteria found in MBSS IBI documents for fish and benthos)	
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input checked="" type="checkbox"/>	other: reference sites stratified by stream order
<b>Additional information</b>	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (100-500 samples/year; single season, multiple sites - watershed level)
	<input checked="" type="checkbox"/>	fish (100-500 samples/year; single season, multiple sites - watershed level)
	<input type="checkbox"/>	periphyton
	<input checked="" type="checkbox"/>	other: macrophytes and amphibians/reptiles (presence/absence only) (100-500 samples/year; single season, multiple sites - watershed level)
<b>Benthos</b>		
sampling gear		D-frame; 500-600 micron mesh
habitat selection		multihabitat, focus on most productive habitat - riffles
subsample size		100 count
taxonomy		genus (family level taxonomy for volunteer Stream Waders Program)
<b>Fish</b>		
sampling gear		backpack electrofisher, barge shocker sometimes used on larger streams, herpetile search also conducted by hand; 1/4" mesh
habitat selection		whatever is in the 75 meter segment
sample processing		length measurement and biomass – batch (gamefish only); anomalies (unusual types or prevalence noted)
subsample		none
taxonomy		species
<b>Habitat assessments</b>		visual based, quantitative measurements, buffer width and vegetation size category, linear and areal extent of eroded banks; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures; quality assurance plan; periodic meetings/ training for biologists; sorting and taxonomic proficiency checks; specimen archival; double entry of data; range checks; peer review of reports; certification program for bioassessment

## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input checked="" type="checkbox"/>	disturbance gradients
	<input checked="" type="checkbox"/>	other: various, depending on needs
<b>Multimetric thresholds*</b>		
transforming metrics into unitless scores		50 <sup>th</sup> percentile of reference population
defining impairment in a multimetric index		10 <sup>th</sup> percentile used as threshold between metric scores of 3 and 1; confidence intervals used to evaluate sample results for attainment decisions
<b>Multivariate thresholds</b>		
defining impairment in a multivariate index		For development of IBI; not current analysis
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>see IBI documents plus interim biocriteria document produced by MDE</i> )
	<input checked="" type="checkbox"/>	precision ( <i>replicate sample/same team, same reach</i> )
	<input checked="" type="checkbox"/>	sensitivity ( <i>classification efficiency</i> )
	<input type="checkbox"/>	bias
	<input checked="" type="checkbox"/>	accuracy ( <i>classification efficiency</i> )
	<input checked="" type="checkbox"/>	other: re-sort in laboratory
<b>Biological data</b>		
Storage		MS Access, SAS primarily, but also use spreadsheets for some applications (data dictionaries are produced for external users - see MBSS publications page)
Retrieval and analysis		SAS, Excel, Quattro pro, ARC View

\*Fish and Benthic IBIs are also combined into a "Combined Biological Index."

# MASSACHUSETTS

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## Program Description

Biological monitoring techniques are an important component of the watershed-based surface water quality monitoring and assessment program administered by the Massachusetts Department of Environmental Protection (MADEP). The goals of this program are to assess whether the surface waters of Massachusetts are of sufficient quality and quantity to support their multiple uses, and to report those findings in watershed assessment reports, the 305(b) Summary of Water Quality Report and the 303(d) List of Impaired Waters. Monitoring is also used to identify causes and sources of water use impairments as the first step toward developing water quality and quantity management strategies.

MADEP biologists assess the condition of resident macroinvertebrate, fish and algal communities in streams to provide a direct measure of the ecological response to the cumulative effects of pollutant loadings and habitat degradation. These bioassessments, coupled with water quality data and other relevant information, form the basis for determining the aquatic life use-support status, as defined in the *Massachusetts Surface Water Quality Standards*.

Rapid bioassessment protocols (RBPs), based on those developed by the USEPA, are used to monitor the integrity of the benthic macroinvertebrate community. A targeted sampling design is employed whereby sites are selected for upstream/downstream comparisons, comparisons against a regional or surrogate reference, or for long-term trend monitoring. Based on scoring of several metrics, four categories of impairment are discerned by the RBP analysis (non-impaired, slightly impaired, moderately impaired, and severely impaired). Approximately 50-75 sites are assessed each year in accordance with a rotating watershed monitoring scheme.

The analysis of the structure of the finfish community as a measure of biological integrity is another component of the water quality monitoring program. MADEP utilizes a standardized method based on RBP V (USEPA 1989) to improve data comparability among wadeable sampling sites. The fish collection procedures involve sampling habitats in relative proportion to their local availability. A representative 100-meter stream reach is selected to include the primary physical habitat characteristics of the stream (i.e., riffle, run, and pool habitats). Electrofishing is the preferred method for obtaining a representative sample of the fish community at each sampling site. Fish (except young-of-the-year) collected within the study reach are identified to species, counted, and examined for external anomalies, (i.e., deformities, eroded fins, lesions, and tumors). Aquatic life use-support status is derived from a knowledge of the environmental requirements (e.g., water temperature and clarity, dissolved oxygen content) and relative tolerance to water pollution of the species collected.

Algae represent a third community that may be assessed. The analysis of the attached algae or periphyton community in shallow streams, or the phytoplankton in deeper rivers and lakes employs an indicator species approach whereby inferences on water quality conditions are drawn from an understanding of the environmental preferences and tolerances of the species present. Because the algal community typically exhibits dramatic temporal shifts in species composition throughout a single growing season, results from a single sampling event are generally not indicative of historical conditions. For this reason the information gained from the algal community assessment is more useful as a supplement to the assessments of other communities that serve to integrate conditions over a longer time period.

In addition to the community analyses described above, MADEP also collects some fish to be assayed for the presence of toxic contaminants in their tissues. The goal of this monitoring element is primarily to provide data for the assessment of the risk to human consumers associated with the consumption of freshwater finfish. In the past fish collection efforts were generally restricted to waterbodies where wastewater discharge data or previous water quality studies indicated potential toxic contamination problems. More recently, concerns about mercury contamination from both local and far-field sources have led to a broader survey of waterbodies throughout Massachusetts. In both cases, nonetheless, the analyses have been restricted to edible fish filets.

## Documentation and Further Information

*Commonwealth of Massachusetts Summary of Water Quality 2000*

*Massachusetts Surface Water Quality Standards*, May 1997: <http://www.state.ma.us/dep/bwp/iww/files/314004.pdf>

For a list of online resources, go to: <http://www.state.ma.us/dep/brp/wm/wmpubs.htm#other>

Jessup, B.K., J. Gerritsen, M.T. Barbour, and R. Haynes. 2001. *Analysis and Interpretation of Pilot Study Data as an Initial Step in the Development of Biological Criteria for Streams and Small Rivers in Massachusetts*. Prepared by Tetra Tech, Inc., for Massachusetts Department of Environmental Protection, Worcester, MA.

# MASSACHUSETTS

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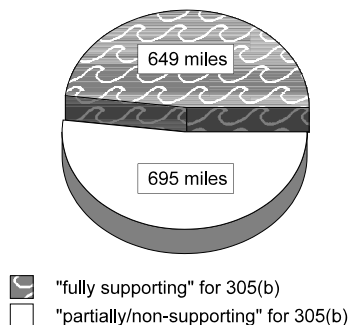
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations, ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input type="checkbox"/>	TMDL assessment and monitoring
	<input checked="" type="checkbox"/>	other: development of numeric biocriteria
<b>Applicable monitoring designs</b>	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>specific river basins or watersheds</i> )
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin ( <i>specific river basins or watersheds</i> )
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b> <i>(determined using a state based program)</i>	<b>8,229</b>
Total perennial miles	7,133
<b>Total miles assessed for biology</b>	<b>1,344</b>
fully supporting for 305(b)	649
partially/non-supporting for 305(b)	695
listed for 303(d)	695
number of sites sampled ( <i>on an annual basis</i> )*	~100
number of miles assessed per site*	site specific

## 1,344 Miles Assessed for Biology



\*The number of sites sampled varies annually, as does the number of miles assessed per site.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Warm water vs. Cold water	
<b>ALU designations in state water quality standards</b>	Three designations: 1. General Aquatic Life Support 2. Cold Water/Warm Water Fishery 3. Shellfish Harvesting	
<b>Narrative Biocriteria in WQS</b>	none - General aquatic life statement found in WQS; informal process in place to translate RBP metrics to level of use support.	
<b>Numeric Biocriteria in WQS</b>	none	
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges
	<input type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Information discussed in water quality assessment reports along with recommendations for management, restoration and further monitoring.	

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>5 - 10 total (on an annual basis)*</b>	
<b>Reference site determinations</b>	<input checked="" type="checkbox"/>	site-specific
	<input checked="" type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Reference site criteria</b>	Least impacted by known point discharges; least impacted by riparian zone land uses; habitat qualities comparable to test sites. For regional reference sites MADEP attempts to locate the least-disturbed sites by conducting extensive reconnaissance throughout the watershed and selecting sites that do not appear to have point or nonpoint sources of pollution upstream from them. Reference sites that represent the various sub-ecoregions that exist in Massachusetts are gradually being identified. This process is not yet complete, however.	
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input checked="" type="checkbox"/>	other: MADEP is working on identifying reference sites to represent various sub-ecoregions
<b>Additional information</b>	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

\*MADEP does not have a fixed set of reference stations situated throughout the state. Rather, during the rotating basin schedule MADEP reconnoissances new reference sites depending upon where the sampling will take place. Therefore the number of reference sites may vary from year to year.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (<100 samples/year; single season, multiple sites - watershed level)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; single season, multiple sites - watershed level)
	<input checked="" type="checkbox"/>	periphyton (<100 samples/year; single season, multiple sites - some at watershed level)
	<input checked="" type="checkbox"/>	other: macrophytes (<100 samples/year; single season, multiple sites - not at watershed level)
<b>Benthos</b>		
sampling gear		multi-plate, rock baskets, collect by hand, single-pole kick-net (45 cm, rectangular, 500-600 micron mesh)
habitat selection		riffle/run (cobble)
subsample size		100 count
taxonomy		combination--genus, species
<b>Fish</b>		
sampling gear		backpack electrofisher, boat electrofisher, seine; 1/8", 3/16" and 1/4" mesh
habitat selection		multihabitat
sample processing		length measurement, biomass - individual, anomalies
subsample		all species, 25 individuals of each
taxonomy		sub-species
<b>Periphyton</b>		
sampling gear		<b>natural substrate:</b> suction device, brushing/scraping device (razor, toothbrush, etc.), collect by hand; <b>artificial substrate:</b> microslides or other suitable substratum
habitat selection		richest habitat, riffle/run (cobble), multihabitat, artificial substrate
sample processing		chlorophyll <i>a</i> / phaeophytin, biomass, taxonomic identification
taxonomy		genus level for soft-bodied algae when possible; diatoms are not cleared
<b>Habitat assessments</b>		visual based; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures; quality assurance plan; periodic meetings, training for biologists; limited taxonomic proficiency checks; specimen archival

## Data Analysis and Interpretation

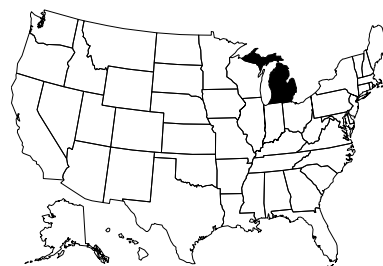
<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds*</b>		
transforming metrics into unitless scores		Follow 1989 EPA RBP guidelines (Figure 6.3-4)
defining impairment in a multimetric index		Follow 1989 EPA RBP guidelines: anything <83% of reference is impaired/impacted
<b>Evaluation of performance characteristics</b>	<input type="checkbox"/>	repeat sampling
	<input checked="" type="checkbox"/>	precision ( <i>duplicate sampling</i> )
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		MS Access 2000
Retrieval and analysis		MS Access 2000 - benthos database customized from EDAS

\*Everything is determined relative to the reference sites; however some parts of this have been refined, including the similarity index thresholds, and MADEP hopes to use biocriteria data to further modify thresholds. MADEP has also evaluated a model community at order level as a substitute for similarity indices (see Novak & Bode, 1992).

# MICHIGAN

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MDEQ Water homepage: <http://www.michigan.gov/deq/1,1607,7-135-3313---,00.html>



## Program Description

In 1997, the Michigan Department of Environmental Quality (MDEQ) completed a report entitled, *A Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters* (Strategy). This Strategy describes the monitoring activities necessary for a comprehensive assessment of water quality in Michigan's surface waters. One component of the Strategy is expanded and improved monitoring of biological integrity and physical habitat.

This program element includes all monitoring conducted for fish and benthic invertebrate community structure, nuisance aquatic plants, algae, and slimes, and assessment of physical habitat. The MDEQ's goal in conducting watershed surveys is to assess 80 percent of the stream and river miles in Michigan over a five-year period.

Enhanced biological integrity and physical habitat monitoring is consistent with existing MDEQ programs and activities. MDEQ uses the existing five-year basin units defined by the NPDES permitting program, which includes 45 watershed units based on drainage to the four Great Lakes. Monitoring activities in each watershed include not only biological integrity, but also fish and wildlife contaminant studies, water chemistry, and sediment chemistry. Integrating the enhanced biological monitoring with the other activities, within the framework of the five-year permitting cycle, will ensure that the monitoring is closely linked with other MDEQ programs and contributes to resource management decisions. Specific objectives of biological integrity and physical habitat monitoring are to:

1. Determine whether waters of the state are attaining standards for aquatic life.
2. Assess the biological integrity of the waters of the state.
3. Determine the extent to which sedimentation in surface waters is impacting indigenous aquatic life.
4. Determine whether the biological integrity of surface waters is changing with time.
5. Assess the effectiveness of BMPs and other restoration efforts in protecting and/or restoring biological integrity and physical habitat.
6. Evaluate the overall effectiveness of MDEQ programs in protecting the biological integrity of surface waters.
7. Identify waters that are high quality, as well as those that are not meeting standards.
8. Identify the waters of the state that are impacted by nuisance aquatic plants, algae, and bacterial slimes.

Rapid, qualitative biological assessments of Wadeable streams and rivers are conducted using the Great Lakes and Environmental Assessment Section [Procedure 51](#), which compares fish and benthic invertebrate communities at a site to the communities that are expected at an un-impacted, or reference, site. This is a key tool used by MDEQ to determine whether waterbodies are attaining Michigan WQS. Because Procedure 51 is meant to be a qualitative, rapid assessment tool, the MDEQ established a contract with the Great Lakes Environmental Center to develop a statistically valid sample design and procedure for detection of trends using benthic macroinvertebrates. This project is scheduled for completion in January 2003.

All biological community data are entered into MDEQ's MS Access database. Biological and habitat data collected as part of the five-year watershed surveys are summarized in watershed reports. The list of these reports is stored in a database that will be accessible to the public via the MDEQ Surface Water Quality Division's website.

## Documentation and Further Information

Michigan Water Quality Report (Year 2000 305(b) Report):  
[http://www.michigan.gov/deq/1,1607,7-135-3313\\_3686\\_3728-12711--,00.html](http://www.michigan.gov/deq/1,1607,7-135-3313_3686_3728-12711--,00.html)

CWA Section 303(d) List: Michigan Submittal for Year 2002:  
[http://www.deq.state.mi.us/documents/deq-swq-gleas-303\\_d\\_Rpt2002b.pdf](http://www.deq.state.mi.us/documents/deq-swq-gleas-303_d_Rpt2002b.pdf)

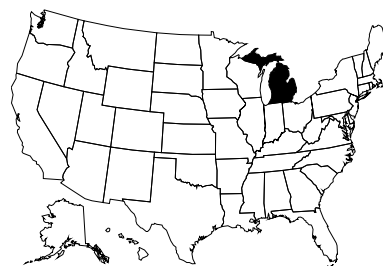
Michigan's WQS, revised April 1999: <http://www.deq.state.mi.us/documents/deq-swq-gleas-305b2002Appl.doc>

MDEQ Biosurveys website:  
[http://www.michigan.gov/deq/0,1607,7-135-3313\\_3686\\_3728-32369--,00.html](http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-32369--,00.html)

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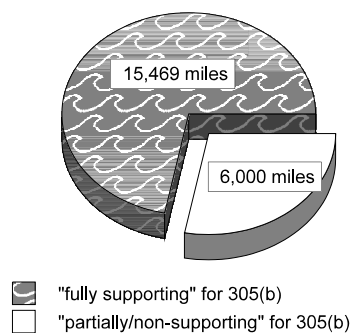
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
<b>Applicable monitoring designs</b>	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects only</i> )
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin ( <i>specific river basins or watersheds and comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b>	<b>49,141</b>
<i>(determined using RF3)</i>	
Total perennial miles	27,873
<b>Total miles assessed for biology</b>	<b>21,469</b>
fully supporting for 305(b)	15,469
partially/non-supporting for 305(b)	6,000
listed for 303(d)	2,600
number of sites sampled	3,500
number of miles assessed per site	—

## 21,469 Miles Assessed for Biology



## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Warm Water vs. Cold Water	
<b>ALU designations in state water quality standards</b>	Three designations: coldwater fisheries, warmwater fisheries, and other indigenous aquatic life and wildlife (per Rule 100 of Michigan's WQS). Coldwater fishery includes any of the following: trout, salmon, whitefish, cisco. Warmwater fishery includes fish species that thrive in relatively warmwater, including any of the following: bass, pike, walleye, panfish.	
<b>Narrative Biocriteria in WQS</b>	none*	
<b>Numeric Biocriteria in WQS</b>	none	
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	TMDL listing and delisting decisions	

\*Michigan does not have narrative biocriteria, per se. However, MI does have tiered ALU designations and numeric procedures (the Gleas Procedure #51) to implement WQS, evaluate nonpoint source impacts, and assess designated uses. According to MDEQ's *Qualitative and Biological Biological Survey Protocols for Wadeable Streams and Rivers* (Procedure #51), "The development of these biological and habitat survey protocols was a result of the increasing demand for a more vigorous and standardized evaluation of nonpoint source impacts. The nature and diversity of the causes of nonpoint pollution created a need for greater refinement and sophistication of the Surface Water Quality Division's standard biological survey procedures in order to assess the degree and causes of these biological impacts."

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>200 total</b>	
<b>Reference site determinations</b>	<input checked="" type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Reference site criteria</b>	excellent biota present	
<b>Characterization of reference sites within a regional context</b>  <i>Not applicable</i>	<input type="checkbox"/>	historical conditions
	<input type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
<b>Additional information</b>	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos ( <i>&gt;500 samples/year; single season, multiple sites - watershed level</i> )
	<input checked="" type="checkbox"/>	fish ( <i>&lt;100 samples/year; single season, multiple sites - watershed level</i> )
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		D-frame and dipnet; 800-900 micron mesh
habitat selection		multihabitat
subsample size		100 count
taxonomy		combination - family, genus
<b>Fish</b>		
sampling gear		backpack electrofisher and pram unit (tote barge)
habitat selection		multihabitat
sample processing		length measurement and anomalies
subsample		none
taxonomy		species
<b>Habitat assessments</b>		visual based; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, specimen archival

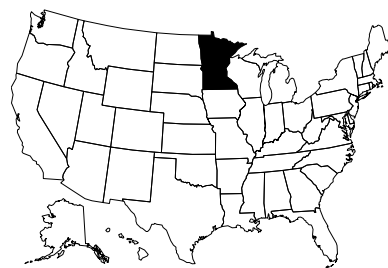
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		Two standard deviations from excellent condition
defining impairment in a multimetric index		Two standard deviations from excellent condition
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling
	<input checked="" type="checkbox"/>	precision ( <i>repeat sampling by teams during round robins over the years</i> )
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		MS Access database, spreadsheets
Retrieval and analysis		SAS, Systat and Statistica

# MINNESOTA

## Contact Information

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## Program Description

The Minnesota Pollution Control Agency (MPCA) Biological Assessment Unit, located in the Environmental Standards and Analysis Section, performs many functions integral to water quality decision-making. Among these, the Unit:

- Develops biological measures of ecological integrity for streams and wetlands.
- Collects and analyzes biological monitoring data.
- Builds a biological monitoring system that includes streams in the 10 major river basins.
- Lays the groundwork for the development of biological indicators for lakes and large rivers.
- Determines biological impairments of rivers and streams for use in TMDL studies
- Coordinates creation of TMDL listing.

## Documentation and Further Information

*2000 Minnesota Water Quality: Surface Water Section, Years 1998 - 1999 305(b) Report:*  
<http://www.pca.state.mn.us/publications/reports/305bfinalreport-2000.pdf>

*Stream Assessment Methods for Use Support:* <http://www.pca.state.mn.us/water/basins/method98.pdf>

*MPCA Water Quality Criteria - Aquatic Life Use Support in Rivers and Streams:*  
<http://www.pca.state.mn.us/water/basins/rivkey98.pdf>

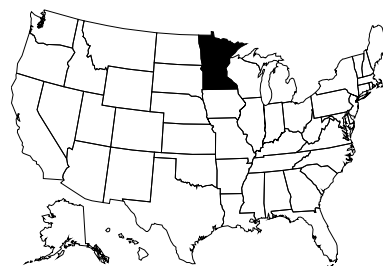
*Minnesota Lake Water Quality Assessment Data: 2000:* <http://www.pca.state.mn.us/water/pubs/lwqar.pdf>

*MPCA Environmental Outcomes Division website:* <http://www.pca.state.mn.us/about/eod.html>

# MINNESOTA

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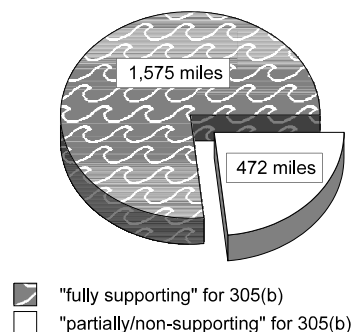
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
<b>Applicable monitoring designs</b>	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) <i>(in specific river basins or watersheds for biocriteria development, problem investigation, and effectiveness monitoring)</i>
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin <i>(in specific river basins or watersheds for condition monitoring and biocriteria development)</i>
	<input checked="" type="checkbox"/>	other: probabilistic by major basin

## Stream Miles

<b>Total miles</b>	<b>91,944</b>
<i>(determined using National Hydrography Database)</i>	
Total perennial miles	32,985
<b>Total miles assessed for biology*</b>	<b>2,047</b>
fully supporting for 305(b)	1,575
partially/non-supporting for 305(b)	472
listed for 303(d)	785
number of sites sampled <i>(on an annual basis)</i>	100
number of miles assessed per site	depends on segment length

## 2,047 Miles Assessed for Biology



\*The discrepancy between 305(b) and 303(d) miles is due to a change in methods related to the threshold level of impairment. The numbers for 303(d) reflect the information from the latest proposed 303(d) list using the new threshold levels. The 305(b) miles will reflect the old threshold levels until the next 305(b) assessments occur.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Class System (1,2,3), Fishery Based Uses and Warm Water vs. Cold Water
<b>ALU designations in state water quality standards</b>	Aquatic life and recreation, Class 2. 4 subclasses: 2A, cold water (salmonid) fishery; 2B cool & warm water fishery; 2C, "indigenous" fishery; 2D, wetlands
<b>Narrative Biocriteria in WQS</b>	Numeric procedures to implement narrative biocriteria are in separate Guidance documents, not part of the water quality standards.
<b>Numeric Biocriteria in WQS</b>	none
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/> assessment of aquatic resources <input type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation) <input checked="" type="checkbox"/> watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Bioassessment information is being used in the TMDL process and to support decisions regarding permitted discharges.

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>35 total</b>
<b>Reference site determinations*</b>	<input type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input checked="" type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Reference site criteria</b>	Reference sites are defined as minimally disturbed reaches/areas within a specific geographic region, within a given aquatic classification framework. The criteria used to define reference sites are based on biology, landuse, and habitat and are adjusted by region (basin, ecoregion, etc).
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input type="checkbox"/> gradient response <input type="checkbox"/> professional judgment <input checked="" type="checkbox"/> other:**
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input checked="" type="checkbox"/> stream type <input type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input checked="" type="checkbox"/> other: At this time MPCA is using major river basin as a framework. This could change once a statewide database is developed.
<b>Additional information</b>	<input type="checkbox"/> reference sites linked to ALU <input type="checkbox"/> reference sites/condition referenced in water quality standards <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

\*Candidate reference sites are initially selected using GIS coverages including landuse, point source, ditching, and feedlot. After the biological sampling has occurred, reference sites are chosen using the biological, habitat, and GIS based information.

\*\*There are regions within Minnesota where *minimally impacted* reference sites will eventually be identified. MPCA has not had the opportunity to develop biological criteria for these areas yet, but is planning to do so within the next five to ten years.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos ( <i>100-500 samples/year; single season, multiple sites - watershed level</i> )
	<input checked="" type="checkbox"/>	fish ( <i>100-500 samples/year; single season, multiple sites - watershed level</i> )
	<input type="checkbox"/>	periphyton
	<input checked="" type="checkbox"/>	other: macrophytes ( <i>&lt;100 samples/year; single season multiple sites – not at watershed level</i> )
<b>Benthos</b>		
sampling gear		D-frame; 500-600 micron mesh
habitat selection		multihabitat
subsample size		300 count
taxonomy		genus
<b>Fish</b>		
sampling gear		backpack and boat electrofishers, and pram unit (tote barge)
habitat selection		multihabitat
sample processing		length measurement, biomass - batch and anomalies
subsample		none
taxonomy		species
<b>Habitat assessments</b>		quantitative measurements; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival

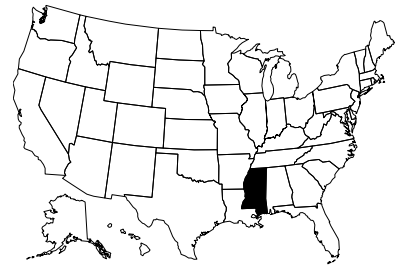
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		95 <sup>th</sup> percentile of all sites
defining impairment in a multimetric index		The percentile of the reference population will vary by major basin because of wide variability between basins regarding the level of human disturbance.
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>10% of all sites are repeated during a season</i> )
	<input checked="" type="checkbox"/>	precision ( <i>A multiyear study, currently 5 years long, is being conducted to evaluate the precision of IBI scores over a long term period. This work is taking place at reference sites and degraded sites - ten sites total.</i> )
	<input checked="" type="checkbox"/>	sensitivity ( <i>sensitivity has been examined by evaluating IBI scores against gradients of disturbance</i> )
	<input type="checkbox"/>	bias
	<input checked="" type="checkbox"/>	accuracy ( <i>accuracy has been informally examined by comparison of IBI scores to expected results from a landuse/habitat rating score</i> )
<b>Biological data</b>		
Storage		database (details not provided)
Retrieval and analysis		Systat

# MISSISSIPPI

## Contact Information

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MDEQ homepage:  
<http://www.deq.state.ms.us>



## Program Description

The Mississippi Department of Environmental Quality (MDEQ) has a Surface Water Monitoring Program (SWMP), which:

- Meets the requirements of Section 106 of CWA,
- Monitors, assesses and reports overall status and trends of surface water quality state-wide,
- Identifies impaired waterbodies and determines causes and sources of impairment,
- Determines effectiveness and supports monitoring and assessment activities of other Surface Water Division (SWD) Programs,
- Addresses surface water quality issues and economic development interests of public concern, and
- Determines better ways of monitoring and assessing surface waters.

Biological data collection, assessment and reporting are an integral component of MDEQ's SWMP and have been for many years. In addition, biological data are a primary assessment component of MDEQ's 305(b) and 303(d) reporting processes. Specifically, macroinvertebrate assessment results are used in the process of determining aquatic life use support and for identifying impaired waterbodies. Macroinvertebrate data are also used to complement other environmental data throughout the TMDL process, including stressor identification and TMDL implementation monitoring. A probabilistic survey design is planned for incorporation into MDEQ's ongoing ambient monitoring network in the future. This approach is intended to produce a more accurate, scientifically defensible and comprehensive assessment of biological condition throughout the state. This will result in collection of biological data at a combination of fixed and random stations each year in conjunction with MS DEQ's Basin Management Approach.

In 2001, MDEQ redesigned its biological monitoring and assessment program to include more rigorous training; field sampling; laboratory sorting, subsampling, and taxonomy; analytical methods; and documentation. It included a comprehensive QA Project Plan with detailed standard operating procedures (SOPs), revision of data entry and database management procedures, and documentation of data quality characteristics throughout the entire assessment process. Approximately 450 Wadeable Stream sites were sampled statewide with the exception of the MS River Alluvial Plain during a winter index period for benthic macroinvertebrates, physical habitat quality, substrate particle size distribution, and selected field and analytical chemistry. Using GIS, the drainage area for the each site was delineated and land use characterized. For five bioregions, reference conditions were developed based on the concept of "best attainable" conditions, and a multimetric index of biological integrity calibrated, the Mississippi Benthic Index of Stream Quality (M-BISQ).

## Documentation and Further Information

*State of Mississippi Water Quality Assessment 2002 Section 305(b) Report, Big Black River Basin Supplement:*  
<http://www.deq.state.ms.us> Click: OPC then Surface Water then 305(b)

*State of Mississippi 2002 List of Waterbodies, 303(d) Report:* <http://www.deq.state.ms.us> Click: TMDLs

*State of Mississippi Water Quality Criteria for Intrastate, Interstate and Coastal Waters, October 2002:*  
<http://www.deq.state.ms.us> Click: MDEQ Regulations then By Type then Water then WPC-1

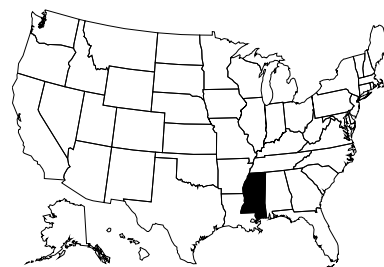
*Quality Assurance Project Plan for 303(d) List Assessment and Calibration of the Index of Biological Integrity for Wadeable Streams in Mississippi.*

*Development and Application of the Mississippi Benthic Index of Stream Quality (M-BISQ).*

# MISSISSIPPI

## Contact Information

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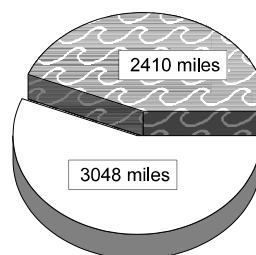
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
<b>Applicable monitoring designs</b>	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) <i>(comprehensive use throughout jurisdiction)</i>
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) <i>(comprehensive use throughout jurisdiction)</i>
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin <i>(comprehensive use throughout jurisdiction)</i>
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b> <i>(determined using RF3)</i>	<b>84,003</b>
Total perennial miles	26,454
<b>Total miles assessed for biology</b>	<b>5,458</b>
fully attaining ALUS for 305(b)	2,410
not fully attaining ALUS for 305(b)	3,048
listed for 303(d)	3,048
number of sites sampled	455
number of miles assessed per site	~12

5,458 Miles Assessed for Biology



☒ "fully supporting" for 305(b)  
☐ "partially/non-supporting" for 305(b)

\*MDEQ implemented a new biological assessment program (started in fall, 2001). Miles assessed for biology and 305(b)/303(d) numbers reflect this change and vary significantly from previous assessments.

NOTE: All information contained in this summary refers to procedures adopted under the *new* bioassessment program.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Single Aquatic Life Use	
<b>ALU designations in state water quality standards</b>	One designation: Fish and Wildlife (biological data are only assessed for fish and wildlife classification)	
<b>Narrative Biocriteria in WQS</b>	Presently, there are no written informal/formal numeric procedures to support narrative biocriteria decisions. Available procedures support a general aquatic life standard.	
<b>Numeric Biocriteria in WQS</b>	none	
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	none	

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>83 total</b>	
<b>Reference site determinations</b>	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Reference site criteria</b>	Surrounding landuse, physical habitat, substrate particle size, water chemistry, biology, and historical information.	
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Stream stratification within regional reference conditions</b>	<input type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
<b>Additional information</b>	<input checked="" type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/> benthos ( <i>100-500 samples/year; single season, multiple sites - broad coverage</i> ) <input type="checkbox"/> fish <input type="checkbox"/> periphyton <input type="checkbox"/> other:
<b>Benthos</b>	
sampling gear	D-frame net (800 x 900 micron mesh) for wadeable streams
habitat selection	multihabitat
subsample size	200 count
taxonomy	genus
<b>Habitat assessments</b>	visual based habitat assessment and modified Wolman Pebble Count; performed with bioassessments
<b>Quality assurance program elements</b>	standard operating procedures, quality assurance plan, periodic meetings and training for biologists, field and laboratory performance audits, sorting and taxonomic proficiency checks, specimen archival

## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/> summary tables, illustrative graphs <input type="checkbox"/> parametric ANOVAs <input checked="" type="checkbox"/> multivariate analysis* <input checked="" type="checkbox"/> biological metrics ( <i>aggregate metrics into an index</i> ) <input checked="" type="checkbox"/> disturbance gradients <input type="checkbox"/> other:
<b>Multimetric thresholds</b>	
transforming metrics into unitless scores	95 <sup>th</sup> percentile of all sites
defining impairment in a multimetric index	25 <sup>th</sup> percentile of reference condition
<b>Evaluation of performance characteristics**</b>	<input checked="" type="checkbox"/> repeat sampling ( <i>different team, same reach; same team, adjacent reach</i> ) <input checked="" type="checkbox"/> precision ( <i>repeat &amp; duplicate field samples, repeat sorting, taxonomic &amp; data checks</i> ) <input checked="" type="checkbox"/> sensitivity ( <i>disturbance gradient for reference &amp; degraded streams</i> ) <input checked="" type="checkbox"/> bias ( <i>repeat, duplicate samples</i> ) <input checked="" type="checkbox"/> accuracy (discrimination efficiency)
<b>Biological data</b>	
Storage	EDAS
Retrieval and analysis	Systat, Statistica and EDAS

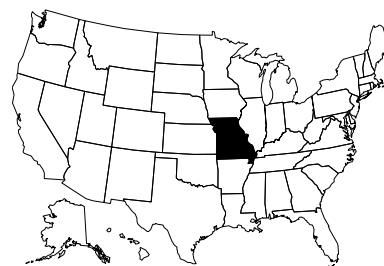
\* Multivariate analysis is being used to *develop* the new index, but the subsequent analysis of biological data will be multimetric.

\*\*Additional evaluation procedures of performance characteristics include: field (biological, habitat and chemistry repeats), lab (pickate rechecks, QC checks), taxonomy (two taxonomists and a third party for precision; reference collection), data entry QC, and metric calculation QC checks.

# MISSOURI

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## Program Description

The overall aquatic biological assessment program for Missouri streams and Wadeable rivers is a multi-agency collaborative effort between the Missouri Department of Conservation (MDC), the Missouri Department of Natural Resources (MDNR), The University of Missouri-Columbia, and the USEPA. The overall program involves a Resource Assessment and Monitoring Program, biological criteria development, monitoring of targeted sites to determine compliance with the designated use of aquatic life protection in the standards, monitoring for 303(d) purposes, and the development of a stream classification system framework.

The Resource Assessment and Monitoring Program is committed to sampling 120 sites per year beginning in 2002. These sites are a combination of targeted reference sites and randomly selected sites. The MDC is responsible for fish sampling, physical habitat assessment, and water quality contaminant sampling (to be analyzed by the USEPA). The MDNR is responsible for sampling macroinvertebrates at 30% of the sites. For the remainder of the sites, samples are collected by MDC and analyzed by the University of Missouri-Columbia. The Resource Assessment and Monitoring Program operates on a five year cycle with statewide random sites collected for one year and random sites in priority watersheds collected for four years. Data will be used to report on the status of Missouri's streams and Wadeable rivers.

The MDNR initiated biological criteria development for Wadeable, perennial streams in 1992. Numeric biocriteria for one trophic level (macroinvertebrate communities) were completed in February 2002. This effort also involved the cooperation of the University of Missouri-Columbia, School of Natural Resources and the Missouri Resource Assessment Partnership. Future biological criteria efforts will add an additional trophic level (fish communities) to Wadeable, perennial streams and will initiate a low level effort to develop numeric criteria for other size ranges of streams and rivers. The numeric criteria and associated components have been used to evaluate compliance with the designated use of aquatic life protection as well as in the assessment of biological communities for 303(d) purposes.

The Missouri Resource Assessment Partnership is an interagency partnership that provides expertise in geographic information systems, remote sensing, and natural resource management. Since 1997, the Missouri Resource Assessment Partnership has been in the process of developing a hierarchical classification framework for Missouri's stream resources. This framework is expected to provide the foundation for biological study designs in the Resource Assessment and Monitoring Program, biological criteria, and targeted studies concerning the designated use of aquatic life protection and 303(d) purposes.

## Documentation and Further Information

Methodology for the 2002 303(d) list, 1998 303(d) list, and Missouri's Water Quality Standards and criteria are all available on the MDNR Water Pollution Control Program homepage: <http://www.dnr.state.mo.us/deq/wpcp/homewpcp.htm>

Fischer, S.A. 2002. *Resource Assessment and Monitoring Program: Standard Operating Procedures - fish sampling*. Missouri Department of Conservation, Columbia, MO.

Sarver, R., S. Harlan, C. Rabeni, and S. Sowa. 2001. *Draft Report - Biological Criteria for Wadeable/Perennial Streams of Missouri*. Prepared by Missouri Department of Natural Resources, Air and Land Protection Division, Environmental Services Program.

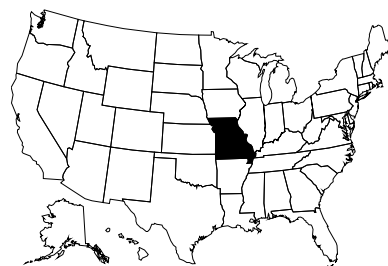
Also available through MDNR: *Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure* (2001); *Stream Habitat Assessment Project Procedure* (2000); *Macroinvertebrate Levels of Taxonomy SOP/FSS/209* (1998); *Biological Criteria for Streams of Missouri - A Final Report to the MO Department of Natural Resources*, University of Missouri, Cooperative Fish and Wildlife Unit; *Quality Control Procedures for Data Processing* (2001) MDNR/WQMS/214.

# MISSOURI

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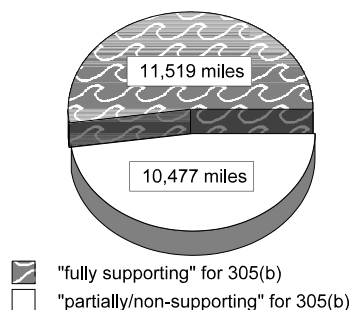
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions ( <i>MDNR only</i> )
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
<b>Applicable monitoring designs</b>	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>comprehensive use throughout jurisdiction by MDNR</i> )
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input checked="" type="checkbox"/>	probabilistic by stream order/catchment area ( <i>comprehensive use throughout jurisdiction and in specific river basins or watersheds by MDC</i> )
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide ( <i>comprehensive use throughout jurisdiction and in specific river basins or watersheds by MDC</i> )
	<input checked="" type="checkbox"/>	rotating basin ( <i>used in specific rivers basins or watersheds by MDNR</i> )
	<input checked="" type="checkbox"/>	other: reference site monitoring

## Stream Miles

<b>Total miles</b>	<b>52,194</b>
<i>(estimated using National Hydrography Database)</i>	
Total perennial miles	22,194
<b>Total miles assessed for biology*</b>	<b>21,996</b>
fully supporting for 305(b)	11,519
partially/non-supporting for 305(b)	10,477
listed for 303(d)	n/a
number of sites sampled ( <i>on an annual basis</i> )	200
number of miles assessed per site	site specific ( <i>MDC</i> ) 0.25 ( <i>MDNR</i> )

## 21,996 Miles Assessed for Biology



\*Miles assessed for aquatic life as reported in Missouri's draft 2002 305(b) Water Quality Report are based on biological, chemical, physical and toxicological data. The status and number of stream miles assessed exclusively for biology is not readily available.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Warm Water vs. Cold Water
<b>ALU designations in state water quality standards</b>	Four designations: General Warm Water Aquatic Life, Limited Warm Water Aquatic Life, Cool Water Fisheries, and Cold Water Fisheries
<b>Narrative Biocriteria in WQS</b>	Procedures used to support narrative biocriteria located in SOPs and draft biocriteria document for Wadeable/Perennial streams housed at MDNR/Air and Land Protection Division, Environmental Services Program
<b>Numeric Biocriteria in WQS</b>	under development (Numeric biocriteria for macroinvertebrate communities in Wadeable, Perennial streams will be completed sometime in 2002. These criteria are intended for inclusion in the water quality standards during the next triennial WQS review.)
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input type="checkbox"/> monitoring (e.g., improvements after mitigation) <input type="checkbox"/> watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	none

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>62 total</b>
<b>Reference site determinations</b>	<input checked="" type="checkbox"/> site-specific ( <i>MDC</i> ) <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input checked="" type="checkbox"/> professional judgment ( <i>MDC</i> ) <input checked="" type="checkbox"/> other: Missouri Ecologic Drainage Units/VST layer ( <i>MDC</i> )
<b>Reference site criteria</b>	<p>Representative of ecoregion and stream size, and in natural condition with respect to habitat, water quality, biological integrity and diversity, watershed land use and riparian conditions            Disturbed habitat = &lt;75% comparable to reference (<i>MDNR</i>)</p> <p><i>MDC</i> uses R-EMAP terminology: perennial flow, relatively high heterogeneity of substrate materials, natural channel morphology, natural hydrograph, natural water color</p>
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input type="checkbox"/> gradient response <input type="checkbox"/> professional judgment <input checked="" type="checkbox"/> other: minimally disturbed in the Ozarks
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input checked="" type="checkbox"/> stream type ( <i>MDNR</i> ) <input type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input checked="" type="checkbox"/> other: <i>MDC</i> is attempting to put reference sites into each of Missouri's 17 Ecologic Drainage Units.
<b>Additional information</b>	<input checked="" type="checkbox"/> reference sites linked to ALU <input checked="" type="checkbox"/> reference sites/condition referenced in water quality standards ( <i>Sarver et al. 2001</i> ) <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos ( <i>100 - 500 samples per year; single season, multiple sites - broad coverage by MDC; multiple seasons, multiple sites - broad coverage for watershed level by MDNR</i> )
	<input checked="" type="checkbox"/>	fish ( <i>100 - 500 samples per year; single season, multiple sites - broad coverage by MDC only</i> )
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		kick net, 500 micron mesh nitex bag
habitat selection		multihabitat
subsample size		900 for glide/pool streams, 1200 for riffle/pool streams
taxonomy		genus, species
<b>Fish</b>		
sampling gear		backpack electrofisher, pram unit (tote barge), and seines; 3/16" mesh for 12' net and 1/4" mesh for 30' net
habitat selection		multihabitat
sample processing		biomass - batch
subsample		batch
taxonomy		species
<b>Habitat assessments</b>		visual based, quantitative measurements ( <i>MDC</i> ), stream width and discharge ( <i>MDNR</i> ); performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival, MDNR data entry QC, certification program for bioassessment within MDC

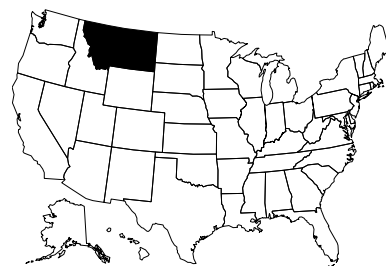
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into index</i> )
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		25 <sup>th</sup> percentile of reference population ( <i>MDNR</i> ); some based on log 10 mean wetted width, mean proportion of reference sites, or specific percentiles ( <i>MDC</i> )
defining impairment in a multimetric index		cumulative score equivalent to 81% of reference condition ( <i>MDNR</i> )
<b>Multivariate thresholds</b>		
defining impairment in a multivariate index		significant departure from mean of reference population ( <i>MDC</i> ), threshold not used by MDNR for criteria but as supporting information only
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>multiple seasons and years by MDNR, annual revisits by MDC</i> )
	<input checked="" type="checkbox"/>	precision ( <i>10% duplicates within reach by MDNR</i> )
	<input checked="" type="checkbox"/>	sensitivity ( <i>evaluated in MDNR pilot project</i> )
	<input checked="" type="checkbox"/>	bias ( <i>MDNR eliminated redundant metrics during pilot project, multiple techniques used by MDC</i> )
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		STORET ( <i>MDC</i> ), MS Access
Retrieval and analysis		SAS ( <i>MDC</i> ), Programming in Visual Basics for MS Access and Sigmapstat ( <i>MDNR</i> )

# MONTANA

## Contact Information

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DEQ Water Quality Monitoring and Assessment homepage:  
[http://www.deq.state.mt.us/wqinfo/MDM/WQMonitoring\\_Assessment.asp](http://www.deq.state.mt.us/wqinfo/MDM/WQMonitoring_Assessment.asp)



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DEQ Water Quality Information homepage: <http://www.deq.state.mt.us/wqinfo/Index.asp>

## Program Description

The Montana Department of Environmental Quality (DEQ) strongly encourages the use of biological data for making ALUS determinations (more than 90% of MT's 303(d) assessments include biological data). It is very difficult to acquire sufficient credible data in Montana without having biological data; thus the incorporation of bioassessment in DEQ's monitoring program is very important.

DEQ is in the second year of collecting macroinvertebrate and periphyton data from fixed station sites that are located on major streams throughout Montana. The primary objective is to determine status and trends. In 2002, the Department initiated an effort to develop vegetation assessment tools for assessing the biological conditions of riparian areas and wetlands and is also looking at amphibians. In the past, wetland macroinvertebrate and diatom communities have been assessed.

DEQ collaborates with a number of agencies and organizations. The Montana Bureau of Land Management has helped fund DEQ's statewide biological monitoring efforts. USGS is collecting chemistry data at most fixed station sites. The Department is also working closely with the wetlands program, universities and the Montana Natural Heritage Program to assess riparian zones. For 303(d) purposes DEQ has collaborated with conservation districts, the Natural Resource Conservation Service, USFS, and USEPA, among others.

In 2000 DEQ developed a new listing methodology that strongly encourages the use of biological data to assess waters for 303(d) purposes. The Department was required to use this methodology for all waters that were previously listed as impaired, but were unfortunately not required to use the new listing methodology for streams that were previously listed as fully supporting ALU. Montana DEQ is also currently forming workgroups to begin the process of developing a state-wide water quality database that can be accessed by federal and state agencies in Montana.

Some challenges include achieving access to private lands and assessing prairie streams that are located in eastern Montana. In the future DEQ intends to develop and implement a random study design to assess the biological condition of smaller order streams.

## Documentation and Further Information

Year 2001 305(b) Report Database and Year 2000 303(d) List Database:  
<http://nris.state.mt.us/scripts/esrimap.dll?name=TMDL&Cmd=INST>

DRAFT 2002 Montana 303(d) List: <http://nris.state.mt.us/scripts/esrimap.dll?name=TMDL2002&Cmd=INST>

Montana's Water Quality Standards and Classifications: <http://www.deq.state.mt.us/wqinfo/Standards/Index.asp>

Water Quality Monitoring Standard Operating Procedures: <http://www.deq.state.mt.us/ppa/mdm/SOP/sop.asp>

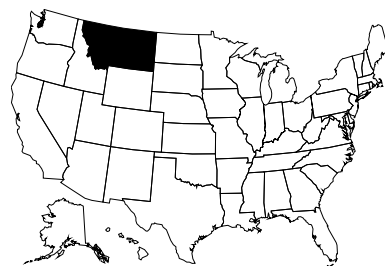
Montana Natural Heritage Program homepage: <http://nhp.nris.state.mt.us/>

# MONTANA

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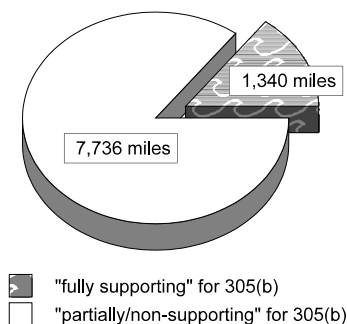
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
<b>Applicable monitoring designs</b>	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects only</i> )
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) ( <i>comprehensive throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	probabilistic by stream order/catchment area ( <i>special projects only</i> )
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide ( <i>special projects only</i> )
	<input type="checkbox"/>	rotating basin
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b> (determined using RF3)	<b>176,750</b>
Total perennial miles	53,221
<b>Total miles assessed for biology*</b>	<b>9,076</b>
fully supporting for 305(b)**	1,340
partially/non-supporting for 305(b)**	7,736
listed for 303(d)	7,736
number of sites sampled ( <i>USGS sites</i> )	~40
number of miles assessed per site	—

## 9,076 Miles Assessed for Biology



\*MT DEQ collects biological data as part of a joint project with USGS to assess 38 sites that are located near the mouth of major streams and rivers. Aside from this, Montana does not have a state biological monitoring program but it is currently under development.

\*\*71% of the waters that were assessed as fully supporting ALU used biological data; 94% of the waters where ALUS was determined to be impaired used biological data.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Class System (A,B,C), Warm Water vs. Cold Water	
<b>ALU designations in state water quality standards</b>	Although there are 9 classifications (A, B, C and subdivided), Class A-Closed is suitable for growth and propagation of fishes and associated aquatic life (among other uses) and Classes A-1, B-1, B-2, B-3, C-1 AND C-2 must have water quality suitable for growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers (among other uses).	
<b>Narrative Biocriteria in WQS</b>	under development (Brief biocriteria language without formal numeric translation mechanism located in WQS. Informal numeric procedures located in guidance document for 303(d) listing purposes complying with WQS.)	
<b>Numeric Biocriteria in WQS</b>	none	
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	TMDL targets	

## Reference Site/Condition Development

<b>Number of reference sites</b>	~50 total (potential reference sites)*	
<b>Reference site determinations</b>	<input checked="" type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Reference site criteria</b>	specific criteria under development; currently using best professional judgment to determine "least impaired" considering geomorphology, habitat, landuse, biology, and chemistry	
<b>Characterization of reference sites within a regional context</b>	<input checked="" type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input checked="" type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: some sites are minimally disturbed**
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input checked="" type="checkbox"/>	elevation
	<input checked="" type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
<b>Additional information</b>	<input checked="" type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

\*In 2001, Montana DEQ began the process of locating reference sites using GIS and sampled ~30 potential reference sites using EMAP methods. A similar effort was made in 1990 when ~38 sites were sampled. In total, Montana has assessed ~50 potential reference sites.

\*\*Montana's regional reference sites are characterized as least disturbed. These sites are used to describe the best potential for a stream given the historical land use. However, many least disturbed reference sites are actually *minimally* disturbed, especially those sites that are located in the Rocky Mountain Ecoregion. In this case the best potential for a stream is near natural condition. These streams are often located in roadless areas, wilderness areas or National Parks.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos ( <i>100 - 500 samples per year; single season, multiple sites - broad coverage</i> )
	<input checked="" type="checkbox"/>	fish ( <i>&lt;100 samples per year; single season, multiple sites - broad coverage</i> )
	<input checked="" type="checkbox"/>	periphyton ( <i>100 - 500 samples per year; single season, multiple sites - broad coverage</i> )
	<input checked="" type="checkbox"/>	other: macrophytes ( <i>&lt;100 samples per year; single season, multiple sites - watershed level</i> )
<b>Benthos</b>		
sampling gear		Hess, D-frame, kick net (1m); 500 - 600 and >800 micron mesh sizes
habitat selection		richest habitat, riffle/run (cobble), multihabitat, woody debris
subsample size		300-500 count
taxonomy		combination - lowest feasible
<b>Fish</b>		
sampling gear		backpack and boat electrofishers, seine; 1/4" mesh
habitat selection		multihabitat
sample processing		length measurement, anomalies
subsample		none
taxonomy		species
<b>Periphyton</b>		
sampling gear		<b>natural substrate:</b> suction device, brushing/scraping device
habitat selection		riffle/run (cobble), multihabitat
sample processing		chlorophyll <i>a</i> / phaeophytin, biomass, taxonomic identification
taxonomy		diatoms (mainly species level), all algae (genus and species)
<b>Habitat assessments</b>		visual based, quantitative measurements, hydrogeomorphology, pebble counts; performed with and independent of bioassessments
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival

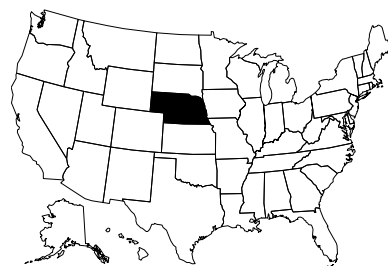
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index and return single metrics</i> )
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		cumulative distribution function
defining impairment in a multimetric index		75% of reference condition
<b>Multivariate thresholds</b>		
defining impairment in a multivariate index		significant departure from mean of reference population
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>duplicates</i> )
	<input checked="" type="checkbox"/>	precision ( <i>splits with USGS and EMAP for bioassessments</i> )
	<input type="checkbox"/>	sensitivity
	<input checked="" type="checkbox"/>	bias ( <i>comparison of different methods</i> )
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		developing use of MS Access and Excel
Retrieval and analysis		Systat, Statmost

# NEBRASKA

## Contact Information

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## Program Description

Nebraska's biological monitoring program was started in 1985 with semi-quantitative methods for collecting fish and macroinvertebrates. The original purpose was to determine naturally occurring biological delineations within the state and to classify streams based on biological characteristics. In 1997, collection methods were changed to the REMAP methodology because the Nebraska Department of Environmental Quality (NDEQ) felt that more quantitative approaches were needed to summarize the data.

NDEQ's program for adapting the metrics to the standards and fine tuning the metrics has been slowed by data management and computer programming problems. NDEQ has a small staff and time constraints have affected this program. NDEQ is experiencing problems with the reference site concept. Since many of the streams have a "sameness" throughout a large area of the state, Nebraska lacks solid reference sites for the ecoregions and stream classes. Except for a few places, it seems most streams are heavily affected by agricultural use. NDEQ has a lot of data, but is having trouble analyzing it.

Due to concerns about the accuracy of the existing biological indices, NDEQ has chosen to reassess past biological data and redefine its indices. Five streams are currently listed on Nebraska's 303(d) list due to biodiversity impacts. Only about 20% of Nebraska's total stream miles are currently assessed for biology in the 305(b) report. These streams are known to be fully supporting (17%) or not supporting (3%).

Nebraska agrees with the reference site concept but needs to determine if appropriate reference sites exist in Nebraska. NDEQ is currently evaluating macroinvertebrate and fish data to locate both excellent and severely impaired sites in order to determine the appropriate habitat conditions that correspond to both extremes. Reference site criteria have not yet been finalized.

## Documentation and Further Information

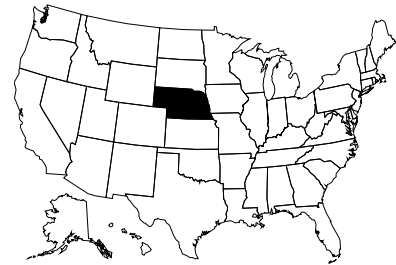
Nebraska DRAFT 2000 305(b) report

DRAFT 2002 303(d) report, 2001, *Comprehensive Study of Water Quality Monitoring*, and Title 117 - Nebraska's Surface Water Quality Standards are available online at <http://www.ndeq.state.ne.us>

# NEBRASKA

## Contact Information

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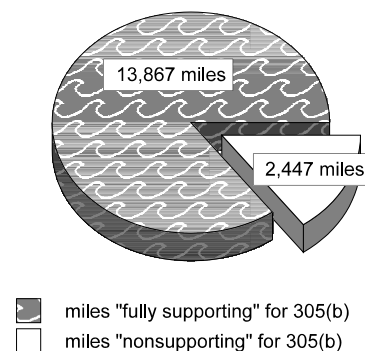
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input type="checkbox"/>	TMDL assessment and monitoring
<b>Applicable monitoring designs</b>	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>specific river basins or watersheds</i> )
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide ( <i>comprehensive use throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	rotating basin ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b>	<b>81,573</b>
<i>(determined using RF3)</i>	
Total perennial miles	16,090
<b>Total miles assessed for biology*</b>	<b>16,314</b>
fully supporting for 305(b)	13,867
non-supporting for 305(b)	2,447
listed for 303(d)	0
number of sites sampled ( <i>on an annual basis</i> )	40
number of miles assessed per site	site specific

## 16,314 Miles Assessed for Biology



\*The 16,314 stream miles assessed for biology are the streams known to be only very high fully supporting (13,867) and very low non-supporting (2,447).

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Class system (A, B, C), Fishery Based Uses, Warm Water vs. Cold Water
<b>ALU designations in state water quality standards</b>	Four designations: Warmwater A, Warmwater B, Coldwater A, Coldwater B
<b>Narrative Biocriteria in WQS</b>	Procedures used to support narrative biocriteria located in various reports, e.g., biological classification, 305(b), bioassessment procedures
<b>Numeric Biocriteria in WQS</b>	none
<b>Uses of bioassessment data in integrated assessments with other environmental data</b> (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input type="checkbox"/> permitted discharges <input type="checkbox"/> monitoring (e.g., improvements after mitigation) <input type="checkbox"/> watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	none

## Reference Site/Condition Development\*

<b>Number of reference sites</b>	<b>38 total</b>
<b>Reference site determinations</b>	<input checked="" type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input checked="" type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Reference Site Criteria</b>	<p>No waste water treatment plants, other point sources, or concentrated animal feeding operations (CAFOs); good instream habitat, riparian habitat, land use and cover, physical and chemical parameters, biological metrics, and faunal assemblages; no altered hydrologic regimes; representativeness.</p> <p>At a minimum, sites need to be in the top 10 to 20 percent of all sites sampled in the ecoregion, with little disturbance and no spills or discharges within sites area.</p>
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input type="checkbox"/> gradient response <input type="checkbox"/> professional judgment <input checked="" type="checkbox"/> other: regionally representative, reasonably attainable
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/> ecoregions (or some aggregate) <i>(there are three ecoregions and six strata with roughly five reference sites in each)</i> <input type="checkbox"/> elevation <input checked="" type="checkbox"/> stream type <input type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input type="checkbox"/> other:
<b>Additional information</b>	<input checked="" type="checkbox"/> reference sites linked to ALU <input type="checkbox"/> reference sites/condition referenced in water quality standards <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

\*Reference site criteria have not been finalized. These responses are based on NDEQ's current efforts to evaluate reference sites and condition.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (<100 samples/year, single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	fish (<100 samples/year, single season, multiple sites - broad coverage)
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		surber, multiplate, collect by hand, D-frame, dipnet; 200 - 400 micron mesh
habitat selection		multihabitat, artificial substrate, woody debris
subsample size		300 count, entire sample
taxonomy		genus, species
<b>Fish</b>		
sampling gear		backpack electrofisher, boat electrofisher, pram unit (tote barge), seine; 1/4" mesh
habitat selection		pool/glide, riffle/run (cobble), multihabitat
sample processing		length measurement (gamefish only), anomalies
subsample		batch
taxonomy		species
<b>Habitat assessments</b>		visual based, quantitative measurements; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan, taxonomic proficiency checks and specimen archival

## Data Analysis and Interpretation\*

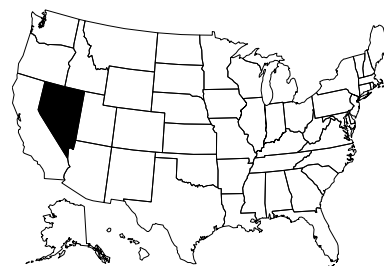
<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		95 <sup>th</sup> percentile of reference population, dependent upon approach
defining impairment in a multimetric index		25 <sup>th</sup> percentile of reference population
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>revisit sites</i> )
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		STORET, Excel and MS Access spreadsheets
Retrieval and analysis		SAS, Minitab

\*NDEQ is testing different indices for validity and, as mentioned earlier, is still exploring reference criteria. Responses are based on NDEQ's current evaluation efforts, which include several changes in the way past biological data were evaluated. Data analysis procedures may change before metrics, indices, and reference sites are finalized.

# NEVADA

## Contact Information

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NDEP Bureau of Water Quality Planning homepage: <http://ndep.state.nv.us/bwqp/>



## Program Description

Nevada began its Bioassessment Program in the year 2000 and has continued to collect biological information on an annual basis. Although the program is in its infancy, the State plans to continue collecting biological data for ambient monitoring and to assist in defining reference conditions and sites. There are seven primary water basins in Nevada and the State has collected biological data annually on four of these basins covering approximately 600 river miles. It is expected the State will continue to collect at these river basins, in addition to new basins and several lakes, until a valid biological baseline has been established over the next four to five years. After such time, the State is expected to switch to an alternating site or basin ambient bioassessment monitoring program.

The program primarily consists of macroinvertebrate collection, physical habitat evaluations, and physical measurements of slope, velocity, flow, dissolved oxygen, specific conductivity, pH, temperature, substrate composition, canopy cover, and width and depth of the sampling area. Periphyton, plankton, and/or chlorophyll sampling is conducted when necessary to assist in defining problem areas. Water chemistry data is collected at sites where the water chemistry is currently unknown. The data will eventually be used in 305(b) and 303(d) reports in addition to basin assessments of stream health. Some NPDES dischargers in the State are voluntarily collecting macroinvertebrates to assess impact to the aquatic environment.

Reference site criteria are currently being defined based on available information. The State expects to use chemical data, habitat assessments, physical measurements, professional knowledge and degrees of human impact to define the conditions and sites. Where reference sites are unavailable, the State expects to use modeling and/or least disturbed sites to evaluate conditions. It is anticipated to take several years for reference sites to be selected.

An independent biological laboratory conducts identification of macroinvertebrates. QA/QC of macroinvertebrate identification consists of approximately 15% of the samples being analyzed by two distinct biological laboratories. Data collected will be stored annually in the Ecological Data Application System (EDAS). Analysis and evaluation of the bioassessment data will be developed as the program progresses and based on the most accurate methods. Reference sites, where appropriate, will be used as a baseline for analysis.

Nevada recently hosted its first bioassessment conference in the State. The conference resulted in the formation of a State Bioassessment Committee consisting of agencies, tribes, and industry. The primary goal of the committee is to evaluate and coordinate protocols, methodologies and sampling in the State. Nevada also participates in the National Aquatic Life Use (ALUS) work group based out of USEPA Headquarters in Washington, D.C. The State is also planning to host an Arid West Aquatic Life Use Workgroup in conjunction with other arid states, tribal entities and USEPA in the next year.

## Documentation and Further Information

Nevada's 305(b) report, September 2000: <http://ndep.state.nv.us/bwqp/305b1998.pdf>

*DRAFT Nevada's 2002 303(d) Impaired Waters List*, June 2002: <http://ndep.state.nv.us/bwqp/303list.pdf>

*Nevada's 1998 303(d) List*, April 1998: <http://ndep.state.nv.us/bwqp/nv303d98.pdf>

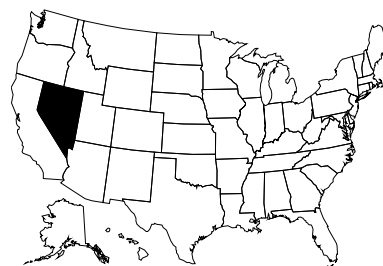
*Draft Continuing Planning Process*, December 2001: <http://ndep.state.nv.us/bwqp/cppdraft.pdf>

Water Quality Standards, narrative and numeric: <http://ndep.state.nv.us/bwqp/stdsw.htm>

# NEVADA

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## Programmatic Elements

<b>Uses of bioassessment within overall water quality program*</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input checked="" type="checkbox"/>	other:
<b>Applicable monitoring designs</b>	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects, specific river basins or watersheds, and comprehensive use throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) ( <i>special projects, specific river basins or watersheds, and comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin ( <i>specific river basins or watersheds and comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	other:

\*Bioassessment information will eventually be used in 303(d) and 305(b) reports.

## Stream Miles

<b>Total miles</b>	<b>143,578</b>
<i>(determined using River Reaches and calculated using GIS coverages.)</i>	
Total perennial miles	14,988
<b>Total miles assessed for biology**</b>	<b>602</b>
fully supporting for 305(b)	0
partially/non-supporting for 305(b)	0
listed for 303(d)	0
number of sites sampled	50-60
number of miles assessed per site	—

\*\*602 miles were assessed per year for 2000 and 2001 by the state (NDEP) and 97 miles were also assessed by others (Dischargers). The state estimates 900 river miles to be assessed in 2002. Since mileage is estimated and Nevada's 2001 data set has not been analyzed, the State has not used biology for 305(b)/303(d); therefore "0" is reported. However, it will be used in the future.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Class System (A,B,C), Fishery Based Uses and Warm Water vs. Cold Water
<b>ALU designations in state water quality standards</b>	Propagation of aquatic life and the levels of warm water and cold water fisheries.
<b>Narrative Biocriteria in WQS</b>	under development
<b>Numeric Biocriteria in WQS</b>	none
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/> assessment of aquatic resources
	<input checked="" type="checkbox"/> cause and effect determinations
	<input type="checkbox"/> permitted discharges
	<input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/> watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Truckee River Restoration projects include the lahontan cutthroat trout.

## Reference Site/Condition Development\*

<b>Number of reference sites</b>	<b>0 total</b>
<b>Reference site determinations</b>	<input checked="" type="checkbox"/> site-specific
	<input checked="" type="checkbox"/> paired watersheds
	<input checked="" type="checkbox"/> regional (aggregate of sites)
	<input checked="" type="checkbox"/> professional judgment
	<input type="checkbox"/> other:
<b>Reference site criteria</b>	This is under development. NDEP expects to use chemical, habitat, physical measurements and least human impact. Where reference sites are unavailable modeling and/or metrics will be used to evaluate conditions.
<b>Characterization of reference sites within a regional context</b>	<input checked="" type="checkbox"/> historical conditions
	<input checked="" type="checkbox"/> least disturbed sites
	<input type="checkbox"/> gradient response
	<input checked="" type="checkbox"/> professional judgment
	<input type="checkbox"/> other:
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/> ecoregions (or some aggregate)
	<input checked="" type="checkbox"/> elevation
	<input checked="" type="checkbox"/> stream type
	<input checked="" type="checkbox"/> multivariate grouping
	<input type="checkbox"/> jurisdictional (i.e., statewide)
	<input type="checkbox"/> other:
<b>Additional information</b>	<input type="checkbox"/> reference sites linked to ALU
	<input type="checkbox"/> reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions ( <i>for fishery based uses</i> )

\*Nevada is in the process of developing reference sites. This section has been completed based on the criteria that will be considered during development.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (<100 samples/year, single season, multiple sites - broad coverage)
	<input type="checkbox"/>	fish
	UD	periphyton (<100 samples/year, single season, multiple sites - watershed level)
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		kick net (1 m); 500-600 micron mesh
habitat selection		riffle/run (cobble) ( <i>when unavailable, use vegetation and sediment</i> )
subsample size		500 count
taxonomy		combination--family, genus, species
<b>Periphyton</b>		
sampling gear		<b>natural substrate:</b> brushing/scraping device (razor, toothbrush, etc.) Periphyton will be routinely collected and analyzed by a professional lab beginning in 2002. Chlorophyll analysis is performed at some stations.
habitat selection		n/a
sample processing		chlorophyll <i>a</i> / phaeophytin and taxonomic identification
taxonomy		genus level for soft-bodied algae when possible; diatoms are not cleared
<b>Habitat assessments</b>		
		quantitative measurements (some sites) and visual based; performed with bioassessments; riffle slope, flow, average width and depth of flow, riffle velocity, canopy cover, some vegetation (grass, scrubs, trees) coverage along riparian zone, reach length, conductivity, temperature and dissolved oxygen
<b>Quality assurance program elements</b>		
		Quality assurance program elements are currently being developed (i.e., standard operating procedures, quality assurance plan, taxonomic proficiency checks, specimen archival).

## Data Analysis and Interpretation\*

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	UD	biological metrics ( <i>NDEP has not yet developed metrics but analysis tools and methods will be developed based on the most accurate method</i> )
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Evaluation of performance characteristics</b>		
	<input checked="" type="checkbox"/>	repeat sampling ( <i>ideally, 5 years worth of data will be collected at each site to determine the variability</i> )
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		EDAS (being developed)
Retrieval and analysis		EDAS (being developed)

\*Analysis tools and methods will be developed more fully in the future.

# NEW HAMPSHIRE

## Contact Information

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*NHDES Watershed Management Bureau, Biomonitoring Program:*  
<http://www.des.state.nh.us/wmb/biomonitoring/>



## Program Description

The New Hampshire Department of Environmental Services (NHDES) has been gathering biological data in wadeable streams and rivers since 1995. The primary goal of this effort is the development of numeric biological criteria in support of the current narrative standard. Biological communities assessed for this purpose are fish and macroinvertebrates. Since the program's inception, the protocols for collecting data have remained fairly consistent. The fish are collected with a backpack electro-shocker for 150 meters, with efforts to include all habitats typical of the stream type. Macroinvertebrate sampling is done by rock baskets deployed for 8 weeks and retrieved in the fall. A visual habitat assessment is also conducted at each station using USEPA's Rapid Bioassessment Protocols for high or low gradient streams, whichever is appropriate.

Since the program's beginnings, over 200 stations have been assessed. These stations are captured in an ArcView coverage that includes watershed delineations specific to the biological sampling station. Efforts are currently underway to determine the degree of human activity in each of the watersheds by evaluating parameters such as land use, population, hazardous waste sites and road density. This type of scoring will help to determine reference quality/least impacted sites.

The Biomonitoring Program is also investigating the need to classify the wadeable streams in New Hampshire. The state is small but very diverse, with low coastal systems and high mountainous regions. It is not yet clear whether it will be necessary to establish unique biological criteria for different regions of the state.

In the past, biomonitoring information has been used for 305(b) reporting and also for 303(d) listing. The Watershed Management Bureau, which is responsible for producing these reports, is currently evaluating the assessment and listing methodologies, using USEPA's CALM guidance. In 2002-2003 the Biomonitoring Program will be testing a probabilistic sampling design for site selection. This type of sampling will allow for greater confidence in statements of statewide water quality, and continue to provide useful data for biocriteria development.

Information about New Hampshire's Biomonitoring Program, including sampling protocols, can be found at <http://www.des.state.nh.us/wmb/biomonitoring/>.

## Documentation and Further Information

*State of New Hampshire 2000 Section 305(b) Water Quality Report:*  
<http://www.des.state.nh.us/wmb/2000-305b.pdf>

*NHDES Biomonitoring Program Protocols, January 2002:*  
<http://www.des.state.nh.us/wmb/biomonitoring/protocols.pdf>

New Hampshire Biomonitoring Program general information: <http://www.des.state.nh.us/wmb/biomonitoring/sites>

# NEW HAMPSHIRE

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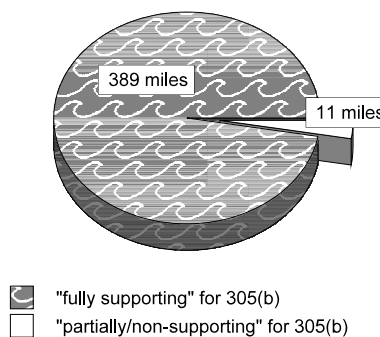
## Programmatic Elements

Use of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input type="checkbox"/>	TMDL assessment and monitoring
	<input checked="" type="checkbox"/>	other: Ecological Risk Assessments
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects and specific river basins or watersheds</i> )
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) ( <i>special projects only</i> )
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input type="checkbox"/>	rotating basin
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b> (State based determination)	<b>10,881</b>
Total perennial miles	8,636
<b>Total miles assessed for biology</b>	<b>400</b>
fully supporting for 305(b)	389
partially/non-supporting for 305(b)	11
listed for 303(d)	0
number of sites sampled ( <i>on an annual basis</i> )	130
number of miles assessed per site*	~3

## 400 Miles Assessed for Biology



\*NHDES will be doing random sampling in the future. For now, 150 meters are assessed and extrapolated to a broader area, roughly three miles per site, though this number does vary.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Class system (A, B, C)
<b>ALU designations in state water quality standards</b>	One designation: Fishable
<b>Narrative Biocriteria in WQS</b>	There aren't any written formal/informal numeric procedures to support narrative biocriteria decisions yet because they are very subjective. Presently, data is being analyzed using New York's metrics.
<b>Numeric Biocriteria in WQS</b>	under development
<b>Uses of bioassessment data in integrated assessments with other environmental data</b> (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/> assessment of aquatic resources <input type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input type="checkbox"/> monitoring (e.g., improvements after mitigation) <input type="checkbox"/> watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	none

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>40 total</b>
<b>Reference site determinations</b>	<input checked="" type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input type="checkbox"/> regional (aggregate of sites) <input checked="" type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Reference site criteria</b>	Generally use best professional judgment. Least disturbed sites are determined following some stratification of characteristics (ArcView coverage, hazardous waste sites, etc.) – it is very visual.
<b>Characterization of reference sites within a regional context</b> <i>Not applicable*</i>	<input type="checkbox"/> historical conditions <input type="checkbox"/> least disturbed sites <input type="checkbox"/> gradient response <input type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Stream stratification within regional reference conditions</b> <i>Not applicable*</i>	<input type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input type="checkbox"/> stream type <input type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input type="checkbox"/> other:
<b>Additional information</b>	<input type="checkbox"/> reference sites linked to ALU <input type="checkbox"/> reference sites/condition referenced in water quality standards <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

\*Regional reference sites not used.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (<100 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; single season, multiple sites - broad coverage)
	<input type="checkbox"/>	periphyton
	<input checked="" type="checkbox"/>	other: amphibians/reptiles (<100 samples/year; single season, multiple sites - broad coverage)
<b>Benthos</b>		
sampling gear		D-frame, kick net (1 meter), multiplate, rock baskets; 500-600 micron mesh
habitat selection		multihabitat, artificial substrate
subsample size		100 count
taxonomy		genus, lowest reasonable taxa
<b>Fish</b>		
sampling gear		backpack electrofisher
habitat selection		multihabitat
sample processing		anomalies
subsample		none
taxonomy		species
<b>Habitat assessments</b>		visual based; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures; quality assurance plan; periodic meetings, training for biologists; sorting and taxonomic proficiency checks; specimen archival; certification program for bioassessment (Biologists must have a certificate of completion of USFWS Electrofishing Course)

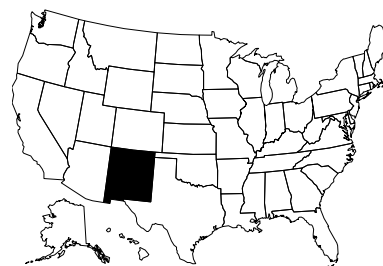
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>return single metrics - use endpoint for each single metric</i> )
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		under development - Presently, only the raw score is tracked – there is no scale of comparison with the reference site yet.
<b>Evaluation of performance characteristics</b>	<input type="checkbox"/>	repeat sampling
<i>Information not provided</i>	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		EDAS
Retrieval and analysis		EDAS

# NEW MEXICO

## Contact Information

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NMED Surface Water Quality Bureau: <http://www.nmenv.state.nm.us/swqb/swqb.html>



## Program Description

Starting in 1998 the New Mexico Environment Department's (NMED) Surface Water Quality Bureau (SWQB) had a goal of monitoring all watersheds in the state on a 5-year cycle. NMED has recently begun to survey fish populations to supplement the data from the NM Department of Game and Fish. NMED uses RBP collection methods and is currently working on assessment methods suitable for the depauperate fish population of New Mexico. The SWQB coordinates with the NM Department of Game and Fish to obtain the most current fishery assessments in the watersheds.

The benefits of this approach are:

- It provides a systematic, detailed review of water quality data and allows for a more efficient use of valuable monitoring resources;
- It provides information at a scale where implementation of corrective activities is feasible;
- With an established order of rotation and predictable sampling in each basin, it is easier to coordinate efforts with other programs and water quality entities, and program efficiency is enhanced and the basis for management decisions is improved.

## Documentation and Further Information

*Water Quality and Water Pollution Control in New Mexico*, 2000 305(b):  
[http://www.nmenv.state.nm.us/swqb/305b\\_2000.html](http://www.nmenv.state.nm.us/swqb/305b_2000.html)

*State of New Mexico Standards for Interstate and Intrastate Surface Waters*, December 16, 2001:  
[http://www.nmenv.state.nm.us/NMED\\_regs/swqb/20\\_6\\_4\\_nmac.html](http://www.nmenv.state.nm.us/NMED_regs/swqb/20_6_4_nmac.html)

*Surface Water Quality Bureau Library*: [http://www.nmenv.state.nm.us/swqb/links.html#WPS\\_Library](http://www.nmenv.state.nm.us/swqb/links.html#WPS_Library)

For a list of and links to *Reports and Publications*, go to:  
<http://www.nmenv.state.nm.us/gwb/Technical%20resources/TSS.html#Reports>

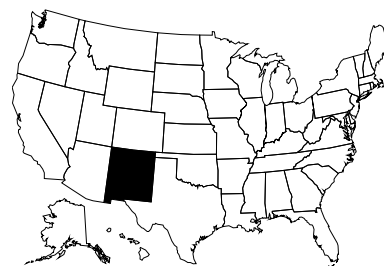
For a *Table of Contents* containing ALL Technical Reports and other information, go to:  
<http://www.nmenv.state.nm.us/gwb/Technical%20resources/TSS.html>

For a list of and links to *Biological Databases*, go to:  
<http://www.nmenv.state.nm.us/gwb/Technical%20resources/TSS.html#Biological>

# NEW MEXICO

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 email: [seva\\_joseph@nmenv.state.nm.us](mailto:seva_joseph@nmenv.state.nm.us)



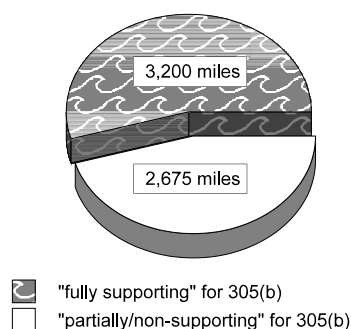
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
<b>Applicable monitoring designs</b>	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects only</i> )
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide ( <i>special projects only</i> )
	<input checked="" type="checkbox"/>	rotating basin ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b> (State based determination)	<b>110,741</b>
Total perennial miles	8,682
<b>Total miles assessed for biology</b>	<b>5,875</b>
fully supporting for 305(b)	3,200
partially/non-supporting for 305(b)*	2,675
listed for 303(d)*	—
number of sites sampled ( <i>on an annual basis</i> )	30
number of miles assessed per site	—

## 5,875 Miles Assessed for Biology



\*A total of 3,080 miles are partially/non-supporting when miles with "impacts observed" are included. NMED is currently working on a 303(d) list.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Fishery Based Uses and Warm Water vs. Cold Water	
<b>ALU designations in state water quality standards</b>	Five designations: Coldwater Fishery, High Quality Coldwater Fishery, Limited Warmwater Fishery, Marginal Coldwater Fishery, and Warmwater Fishery	
<b>Narrative Biocriteria in WQS</b>	none	
<b>Numeric Biocriteria in WQS</b>	none	
<b>Uses of bioassessment data in integrated assessments with other environmental data</b> (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	none	

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>200 total</b>	
<b>Reference site determinations</b>	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Reference site criteria</b>	The least disturbed sites are picked according to best professional judgment (based on chemistry, quantitative habitat measurements, visual indicators, etc). There are plans to shift to RIVPACS as biocriteria are developed during the next few years.	
<b>Characterization of reference sites within a regional context</b>  <i>Not applicable</i>	<input type="checkbox"/>	historical conditions
	<input type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Stream stratification within regional reference conditions</b>	<input type="checkbox"/>	ecoregions (or some aggregate)
	<input checked="" type="checkbox"/>	elevation ( <i>preliminary ecoregions are based on elevation and other habitat parameters</i> )
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
<b>Additional information</b>	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (30 samples/year; single season, multiple sites - watershed level)
	<input checked="" type="checkbox"/>	fish (30 samples/year; single season, multiple sites - watershed level)
	<input checked="" type="checkbox"/>	periphyton* (9 samples/year; single observation, limited sampling)
	<input checked="" type="checkbox"/>	other: phytoplankton (9 samples/year; single observation, limited sampling)
<b>Benthos</b>		
sampling gear		Hess, D-frame, kick net (1 meter); 500-600 micron mesh
habitat selection		riffle/run (cobble)
subsample size		300 count
taxonomy		combination (it depends on the family--some to genus, some to species level)
<b>Fish</b>		
sampling gear		backpack and bank electrofisher; 1/4" mesh
habitat selection		multihabitat
sample processing		length measurement and anomalies
subsample		batch
taxonomy		species
<b>Periphyton*</b>		
sampling gear		<b>natural substrate:</b> collect by hand; <b>artificial substrate:</b> periphytometer
habitat selection		richest habitat and multihabitat
sample processing		taxonomic identification
taxonomy		diatoms only
<b>Habitat assessments**</b>		visual based, hydrogeomorphology; and the RBP assessment is conducted with the bioassessment. NMDE may also conduct a Rosgen type hydrogeomorphological assessment, including pebble counts, independently of the bioassessment.
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan, sorting proficiency checks and specimen archival

\*Periphyton is collected primarily from lakes. It is only collected from streams in response to a specific problem or when looking at a certain impairment – sampling is very minimal (<10).

\*\*Up to this point bioassessments have been conducted as described in the EPA's RBP. These methods are just now starting to be refined for regional applicability.

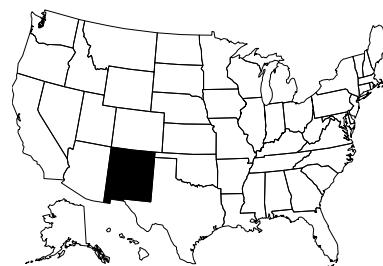
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		95 <sup>th</sup> percentile of reference population
defining impairment in a multimetric index		95 <sup>th</sup> percentile of reference population
<b>Evaluation of performance characteristics</b>		
<i>Not currently evaluated</i>	<input type="checkbox"/>	repeat sampling
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		Just recently started using MS Access. All historic data (1977 - 1999) are in STORET
Retrieval and analysis		In the process of moving from STORET to MS Access; some data are also in Excel

# NEW MEXICO

## Contact Information

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NMED Surface Water Quality Bureau: <http://www.nmenv.state.nm.us/swqb/swqb.html>



## Program Description

Starting in 1998 the New Mexico Environment Department's (NMED) Surface Water Quality Bureau (SWQB) had a goal of monitoring all watersheds in the state on a 5-year cycle. NMED has recently begun to survey fish populations to supplement the data from the NM Department of Game and Fish. NMED uses RBP collection methods and is currently working on assessment methods suitable for the depauperate fish population of New Mexico. The SWQB coordinates with the NM Department of Game and Fish to obtain the most current fishery assessments in the watersheds.

The benefits of this approach are:

- It provides a systematic, detailed review of water quality data and allows for a more efficient use of valuable monitoring resources;
- It provides information at a scale where implementation of corrective activities is feasible;
- With an established order of rotation and predictable sampling in each basin, it is easier to coordinate efforts with other programs and water quality entities, and program efficiency is enhanced and the basis for management decisions is improved.

## Documentation and Further Information

*Water Quality and Water Pollution Control in New Mexico*, 2000 305(b):  
[http://www.nmenv.state.nm.us/swqb/305b\\_2000.html](http://www.nmenv.state.nm.us/swqb/305b_2000.html)

*State of New Mexico Standards for Interstate and Intrastate Surface Waters*, December 16, 2001:  
[http://www.nmenv.state.nm.us/NMED\\_regs/swqb/20\\_6\\_4\\_nmac.html](http://www.nmenv.state.nm.us/NMED_regs/swqb/20_6_4_nmac.html)

*Surface Water Quality Bureau Library*: [http://www.nmenv.state.nm.us/swqb/links.html#WPS\\_Library](http://www.nmenv.state.nm.us/swqb/links.html#WPS_Library)

For a list of and links to *Reports and Publications*, go to:  
<http://www.nmenv.state.nm.us/gwb/Technical%20resources/TSS.html#Reports>

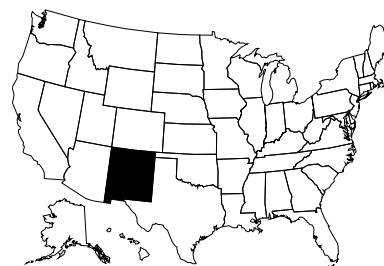
For a *Table of Contents* containing ALL Technical Reports and other information, go to:  
<http://www.nmenv.state.nm.us/gwb/Technical%20resources/TSS.html>

For a list of and links to *Biological Databases*, go to:  
<http://www.nmenv.state.nm.us/gwb/Technical%20resources/TSS.html#Biological>

# NEW MEXICO

## Contact Information

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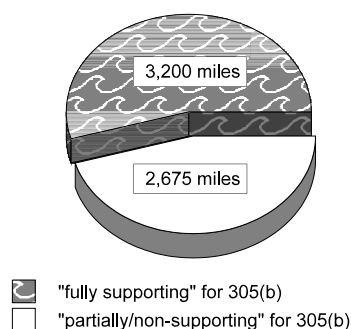
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
<b>Applicable monitoring designs</b>	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects only</i> )
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide ( <i>special projects only</i> )
	<input checked="" type="checkbox"/>	rotating basin ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b> (State based determination)	<b>110,741</b>
Total perennial miles	8,682
<b>Total miles assessed for biology</b>	<b>5,875</b>
fully supporting for 305(b)	3,200
partially/non-supporting for 305(b)*	2,675
listed for 303(d)*	—
number of sites sampled ( <i>on an annual basis</i> )	30
number of miles assessed per site	—

## 5,875 Miles Assessed for Biology



\*A total of 3,080 miles are partially/non-supporting when miles with "impacts observed" are included. NMED is currently working on a 303(d) list.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Fishery Based Uses and Warm Water vs. Cold Water	
<b>ALU designations in state water quality standards</b>	Five designations: Coldwater Fishery, High Quality Coldwater Fishery, Limited Warmwater Fishery, Marginal Coldwater Fishery, and Warmwater Fishery	
<b>Narrative Biocriteria in WQS</b>	none	
<b>Numeric Biocriteria in WQS</b>	none	
<b>Uses of bioassessment data in integrated assessments with other environmental data</b> (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	none	

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>200 total</b>	
<b>Reference site determinations</b>	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Reference site criteria</b>	The least disturbed sites are picked according to best professional judgment (based on chemistry, quantitative habitat measurements, visual indicators, etc). There are plans to shift to RIVPACS as biocriteria are developed during the next few years.	
<b>Characterization of reference sites within a regional context</b>  <i>Not applicable</i>	<input type="checkbox"/>	historical conditions
	<input type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Stream stratification within regional reference conditions</b>	<input type="checkbox"/>	ecoregions (or some aggregate)
	<input checked="" type="checkbox"/>	elevation ( <i>preliminary ecoregions are based on elevation and other habitat parameters</i> )
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
<b>Additional information</b>	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (30 samples/year; single season, multiple sites - watershed level)
	<input checked="" type="checkbox"/>	fish (30 samples/year; single season, multiple sites - watershed level)
	<input checked="" type="checkbox"/>	periphyton* (9 samples/year; single observation, limited sampling)
	<input checked="" type="checkbox"/>	other: phytoplankton (9 samples/year; single observation, limited sampling)
<b>Benthos</b>		
sampling gear		Hess, D-frame, kick net (1 meter); 500-600 micron mesh
habitat selection		riffle/run (cobble)
subsample size		300 count
taxonomy		combination (it depends on the family--some to genus, some to species level)
<b>Fish</b>		
sampling gear		backpack and bank electrofisher; 1/4" mesh
habitat selection		multihabitat
sample processing		length measurement and anomalies
subsample		batch
taxonomy		species
<b>Periphyton*</b>		
sampling gear		<b>natural substrate:</b> collect by hand; <b>artificial substrate:</b> periphytometer
habitat selection		richest habitat and multihabitat
sample processing		taxonomic identification
taxonomy		diatoms only
<b>Habitat assessments**</b>		
		visual based, hydrogeomorphology; and the RBP assessment is conducted with the bioassessment. NMDE may also conduct a Rosgen type hydrogeomorphological assessment, including pebble counts, independently of the bioassessment.
<b>Quality assurance program elements</b>		
		standard operating procedures, quality assurance plan, sorting proficiency checks and specimen archival

\*Periphyton is collected primarily from lakes. It is only collected from streams in response to a specific problem or when looking at a certain impairment – sampling is very minimal (<10).

\*\*Up to this point bioassessments have been conducted as described in the EPA's RBP. These methods are just now starting to be refined for regional applicability.

## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		95 <sup>th</sup> percentile of reference population
defining impairment in a multimetric index		95 <sup>th</sup> percentile of reference population
<b>Evaluation of performance characteristics</b>		
<i>Not currently evaluated</i>	<input type="checkbox"/>	repeat sampling
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		Just recently started using MS Access. All historic data (1977 - 1999) are in STORET
Retrieval and analysis		In the process of moving from STORET to MS Access; some data are also in Excel

# NEW YORK

## Contact Information

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NYSDEC homepage: [www.dec.state.ny.us/website/dow/index.html](http://www.dec.state.ny.us/website/dow/index.html)



## Program Description

The Stream Biomonitoring Unit of the New York State Department of Environmental Conservation (NYSDEC) was formed in 1972. The primary objective of the Unit is to assess the water quality of streams and rivers in New York State using aquatic invertebrate communities. Secondary objectives include taxonomic investigations, invertebrate tissue analysis, and public outreach. The unit presently consists of five biologists: Robert Bode, Margaret Novak, Lawrence Abele, Diana Heitzman, and Alexander Smith.

The Stream Biomonitoring Unit is part of the ambient surface water monitoring team at NYSDEC. Water quality is assessed to determine the level of designated use support and the primary factors causing the impacts. In addition to community assessments, invertebrates are collected for tissue analysis to determine if elevated levels exist for metals, pesticides, PCBs, or PAHs. Biological monitoring using benthic invertebrate communities is the primary monitoring tool for the initial screening phase within the watersheds, providing a coverage of 150-200 streams each year. Additionally, biomonitoring is used to conduct multi-site intensive surveys on approximately 10 streams each year to provide baseline data and trend monitoring data or to trackdown sources of xenobiotic substances.

Assessments based on macroinvertebrate sampling are used extensively in 305(b) reports and the Priority Water List, and to a lesser extent in 303(d) reports. Assessments generally do not directly address the designated uses of drinking, swimming, or fishing, contained in the State water quality standards, although they provide sound basis for determination of aquatic life support (reported in 305b) and relate secondarily to the designated use of fish propagation and survival. Biocriteria are addressed by the Biological Impairment Criteria, which are used to define impairment by exceedances of metrics measured upstream and downstream of a discharge. The primary assessment method using benthic macroinvertebrates is based on a multimetric scale divided into four levels of impairment, ranging from non-impacted to severely impacted. Although nearly all the collection of biological data remains within the Unit, many studies are conducted in cooperation with other New York State agencies (NYS Museum), federal agencies (USGS, USEPA), neighboring states (Vermont, Massachusetts, New Jersey), and non-governmental organizations (Hudson Basin River Watch, Trout Unlimited, Nature Conservancy).

### Accomplishments

- publication of a manual for the identification of larvae of Chironomidae (1980)
- development of methods for the Rapid Biological Assessment of streams (1983)
- establishment of biological impairment criteria (1990)
- publication of Percent Model Affinity, a community analysis technique (1992)
- documentation of 20-year trends in water quality in New York State (1993)
- development of Impact Source Determination, a pollution identification method (1995)

### Future program directions and challenges

- continuing long-term trend monitoring
- providing maximum biomonitoring coverage of streams in New York State
- integrating more assessments with diatom and fish data
- developing invertebrate identification aids using digital photography and the NYSDEC website
- capturing biodiversity information outside of the subsampling process

## Documentation and Further Information

*New York State Water Quality 2000*, 305(b) Report, October 2000: <http://www.dec.state.ny.us/website/dow/305b00.pdf>

Draft 2002 Section 303(d) list: <http://www.dec.state.ny.us/website/dow/303dcalm.pdf>

Bode, R. W., M.A. Novak, and L.E. Abele, 1996. Quality assurance work plan for biological stream monitoring in New York State. New York State Department of Environmental Conservation Technical Report, 89 pages.

# NEW YORK

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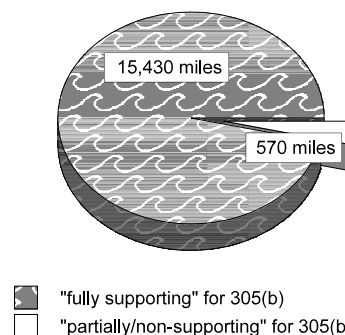
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input type="checkbox"/>	TMDL assessment and monitoring
<b>Applicable monitoring designs</b>	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>comprehensive use throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) ( <i>comprehensive use throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	probabilistic by stream order/catchment area ( <i>special projects only</i> )
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b>	<b>52,337</b>
<i>(determined using a state based program)</i>	
Total perennial miles	46,266
<b>Total miles assessed for biology*</b>	<b>16,000</b>
fully supporting for 305(b)	15,430
partially/non-supporting for 305(b)	570
listed for 303(d)	484
number of sites sampled	800
number of miles assessed per site	20

## 16,000 Miles Assessed for Biology



\*These numbers represent primarily stream miles (roughly 85-90%), but there are some river miles included due to program overlap in metrics, etc. It would be very difficult to separate the data for these two waterbody types. Also, there is a discrepancy between 305(b) partially/non-supporting and 303(d) stream miles because the 1998 303(d) list did not include all impaired waters, just impaired waters suitable for TMDLs. Also, the 305(b) and 303(d) lists, up until now, have been developed independent of each other.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Fishery Based Uses	
<b>ALU designations in state water quality standards</b>	One designation: Fish propagation and survival	
<b>Narrative Biocriteria in WQS</b>	none - New York does have <i>biological impairment criteria</i> (see footnote), but these are not found in the water quality standards.	
<b>Numeric Biocriteria in WQS</b>	none	
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to their designated ALU</b>	none	

## Reference Site/Condition Development

<b>Number of reference sites</b>	not applicable*	
<b>Reference site determinations</b>	<input checked="" type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Reference site criteria</b>	For application of biological impairment criteria, reference sites are control sites located upstream of a suspected source of impairment.	
<b>Characterization of reference sites within a regional context</b>  <i>Not applicable*</i>	<input type="checkbox"/>	historical conditions
	<input type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Stream stratification within regional reference conditions</b>  <i>Not applicable*</i>	<input type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
<b>Additional information</b>	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input type="checkbox"/>	some reference sites represent acceptable human-induced conditions

\*Reference sites are used in the following manner only: NYSDEC's reference sites are merely site-specific "control" sites, used strictly used for rating the water quality near a suspected source of impairment. This is done by collecting water samples at the source of impairment and upstream of the source, and then *biological impairment criteria* are applied for rating purposes. For example, if more than eight species are lost between the two samples, then the impairment criteria have been exceeded and the stream section would be considered significantly impaired. Thus the biological impairment criteria define how much change is allowed from upstream to downstream.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos ( <i>100-500 samples/year; single season, multiple sites - watershed level</i> )
	<input checked="" type="checkbox"/>	fish ( <i>&lt;100 samples/year; single season, multiple sites - not at watershed level</i> )
	<input checked="" type="checkbox"/>	periphyton ( <i>&lt;100 samples/year; single season, multiple sites - not at watershed level</i> )
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		multiplate, Ponar grab sampler, dipnet; >800 micron mesh
habitat selection		riffle/run (cobble)
subsample size		100 count
taxonomy		genus, species, combination
<b>Fish</b>		
sampling gear		backpack electrofisher, 1/4" mesh
habitat selection		pool/glide, riffle/run (cobble)
sample processing		counts only
subsample		100 count
taxonomy		species
<b>Periphyton</b>		
sampling gear		<b>natural substrate:</b> suction device, brushing/scraping device (razor, toothbrush, etc.), from macrophyte surfaces; <b>artificial substrate:</b> collect by hand (multihabitat) using a knife blade and eyedropper
habitat selection		multihabitat
sample processing		taxonomic identification
taxonomy		diatoms only, species
<b>Habitat assessments</b>		quantitative measurements; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures; quality assurance plan; periodic meetings; training for biologists; sorting proficiency checks; taxonomic proficiency checks; specimen archival

\*Water quality assessments using benthos are based on a multimetric scale divided into 4 levels of impairment ranging from non-impacted to severely impacted (see below). NYSDEC's bioassessment program had periphyton monitoring capabilities in 1999 and 2000, but this has since been dropped and it is not clear if the sampling will be continued. Fish sampling is conducted by another Division within NYSDEC for a limited number of sites per year.

## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index and return single metrics</i> )
	<input type="checkbox"/>	disturbance gradients
	<input checked="" type="checkbox"/>	other: Impact Source Determination using cluster analysis
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		transformed into 4 impact categories, using approximately 25 <sup>th</sup> , 50 <sup>th</sup> , and 75 <sup>th</sup> percentiles of database
defining impairment in a multimetric index		transformed into 4 impact categories using approximately 25 <sup>th</sup> , 50 <sup>th</sup> , and 75 <sup>th</sup> percentiles**
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>sampling same site in different flow regime years</i> )
	<input checked="" type="checkbox"/>	precision ( <i>QA checks on subsampling</i> )
	<input checked="" type="checkbox"/>	sensitivity ( <i>comparisons with diatom sampling, fish sampling</i> )
	<input checked="" type="checkbox"/>	bias ( <i>replicate sampling to test for sampler differences</i> )
	<input checked="" type="checkbox"/>	accuracy ( <i>comparisons with toxicity testing, chemical sampling</i> )
<b>Biological data</b>		
Storage		data are entered in Excel spreadsheets, then transferred to FoxPro
Retrieval and analysis		In-house programs in FoxPro

\*\*The impairment threshold is not defined using reference sites. Instead, NYSDEC creates impact categories using all of the data from the sites: everything >75<sup>th</sup> percentile is considered non-impacted/good.

# NORTH CAROLINA

## Contact Information

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## Program Description

### Benthic Macroinvertebrates

The Biological Assessment Unit of NCDENR uses aquatic macroinvertebrates as one type of indicator of biological integrity in streams and rivers. A swamp-sampling method is under development with sampling occurring in winter/early spring. North Carolina biologists first began collecting data in the late 1970s, and began using consistent sampling in 1983. Collection methods include a standard qualitative method (applicable for most between-site and/or between-date comparisons and used for all evaluations of impaired streams - those on the state 303(d) list), and the EPT method (an abbreviated version of the regular qualitative technique used to quickly determine between-site differences in water quality). Benthic samples are processed on site at each location. Another collection method is used for swamp streams. The boat sampling technique for nonwadeable freshwater rivers is an adaptation of the standard qualitative method.

Bioclassification criteria have been developed that are based on the number of intolerant EPT taxa present and the relative pollution tolerance of each taxa, as summarized in a Biotic Index for standard evaluation (EPT uses taxa richness only). Stream and river reaches are then given a final bioclassification of either Excellent, Good, Good/Fair, Fair or Poor. These bioclassifications, which have been developed for major ecoregions, are used to assess the various impacts of both point source discharges and nonpoint source runoff.

Beginning in 1991, the benthos summer sampling effort was directed toward specific river basins in given years based on the NPDES permitting schedule. This basin-wide monitoring is generally conducted three years prior to the year of permit renewal for the basin. This allows biological data to be incorporated in basin assessment, and subsequently into the management plan for each basin. Benthos data, by sub-basin, is incorporated into an Environmental Sciences Branch assessment report that also includes a review of pertinent data and information from other sources.

Between 110 and 130 wadeable sites are sampled for benthos each year during basinwide monitoring, and additional sites are sampled for special studies. The resulting information is used to document both spatial and temporal changes in water quality and to complement water chemistry analyses, fish community data, and habitat evaluations. In addition to assessing the effects of water pollution, biological information is also used to define High Quality or Outstanding Resource Waters, support enforcement of stream standards, and measure improvements associated with management actions. The results of biological investigations have been an integral part of North Carolina's basinwide monitoring program. Benthos data is the primary source for use support determinations.

### Fish Community

To the public, the condition of the fishery is one of the most meaningful indicators of ecological integrity. Fish occupy the upper levels of the aquatic food web and are both directly and indirectly affected by chemical and physical changes in the environment. The Biological Assessment Unit employs a standard method for assessing streams' biological integrity by examining the structure and health of fish communities. This assessment incorporates information about species richness and composition, trophic composition, fish abundance, and fish condition. Criteria for the 12 metrics used in the North Carolina Index of Biological Integrity (NCIBI) are based on reference site data collected from groupings of river basins with similar fauna. The reference site sampling began in 1999, and fish community samples are now given a bioclassification similar to the benthos sites. Approximately 90 basinwide fish sites are sampled annually. Fish community data are used in the same ways as benthos data.

### Use Support

North Carolina has moved toward assessing use support for each use class. Benthos and fish data are used for the evaluation of aquatic life standards. Biological data are typically given more weight than chemical data for use support. Sites with data from more than one trophic level are evaluated on a site specific basis for use support.

## Documentation and Further Information

North Carolina 2000 305(b) Report: <http://h2o.enr.state.nc.us/bepu/download.html>

SOPs Biological Monitoring, Stream Fish Community Assessment & Fish Tissue: <http://www.esb.enr.state.nc.us/BAUwww/IBI%20Methods%202001.pdf>

SOPs for Benthic Macroinvertebrates: <http://www.esb.enr.state.nc.us/BAUwww/benthossop.pdf>

Benthic Macroinvertebrate Sampling and Narrative Criteria: <http://www.esb.enr.state.nc.us/BAUwww/benthosdata.pdf>

# NORTH CAROLINA

## Contact Information

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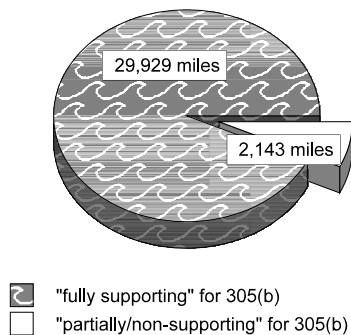
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input checked="" type="checkbox"/>	other: 303(d) listing
<b>Applicable monitoring designs</b>	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (comprehensive use throughout jurisdiction)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (comprehensive use throughout jurisdiction)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin (comprehensive use throughout jurisdiction)
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b>	<b>37,672</b>
<i>(State based determinations)</i>	
Total perennial miles	—
<b>Total miles assessed for biology*</b>	<b>32,072</b>
fully supporting for 305(b)	29,929
partially/non-supporting for 305(b)	2,143
listed for 303(d)	2,143
number of sites sampled (on an annual basis)**	350
number of miles assessed per site	91.6

## 32,072 Miles Assessed for Biology



\*Presently, biological sites are not separated from chemical for reporting purposes. However, Aquatic Life usages will be based primarily on biological assessment in the future. The 303(d) list is due before all assessments were completed (roughly 99% of partially/non supporting waters for 305(b) list). Thus, the number of miles assessed using biological data can't be confirmed because so many sources of information are used to make use support assessments. It can be assumed that using the current methodology of breaking out use support ratings by category (i.e., aquatic life), all the waters assessed in this category could be added up into miles. However, this method has only been applied to 6 of the 17 basins in North Carolina. NCDENR may have these numbers in the next few years.

\*\*Best professional estimate of the number of sites sampled since the program's inception is 5000 benthos, 600 fish and 4000 phytoplankton samples (this is very good coverage of sites within river basins for mainstem and major tributaries).

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Class System (A,B,C)
<b>ALU designations in state water quality standards</b>	"Aquatic life propagation and maintenance of biological integrity..." applies as a best usage for Class C and Class WS-I waters.
<b>Narrative Biocriteria in WQS</b>	Procedures used to support narrative biocriteria located in SOPs for biological assessment
<b>Numeric Biocriteria in WQS</b>	none (Located in SOPs for biological assessment but not in water quality standards.)
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation) <input checked="" type="checkbox"/> watershed based management
<b>Uses of bioassessment/ biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Biological data have been used to pinpoint degraded areas and to validate improvement after management activities have been completed.

## Reference Site/Condition Development

<b>Number of reference sites</b>	300 total
<b>Reference site determinations</b>	<input type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Reference site criteria</b>	Must achieve an excellent bioclassification or meet certain land use criteria (percent forest, no major dischargers, etc). Benthos reference sites: EPT criteria and biotic index criteria; fish reference sites: IBI criteria.
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input type="checkbox"/> gradient response <input type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/> ecoregions (or some aggregate) <input checked="" type="checkbox"/> elevation <input checked="" type="checkbox"/> stream type <input type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input type="checkbox"/> other:
<b>Additional information</b>	<input checked="" type="checkbox"/> reference sites linked to ALU <input type="checkbox"/> reference sites/condition referenced in water quality standards <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos ( <i>100-500 samples/year; multiple seasons, multiple sites – broad coverage for watershed level</i> )
	<input checked="" type="checkbox"/>	fish ( <i>&lt;100 samples/year; multiple seasons, multiple sites – broad coverage for watershed level</i> )
	<input checked="" type="checkbox"/>	periphyton, ( <i>&lt;100 samples/year; single observation, limited sampling</i> )
	<input checked="" type="checkbox"/>	other: phytoplankton ( <i>&gt;500 samples/year; multiple seasons, multiple sites – broad coverage for watershed level</i> ) and macrophytes ( <i>&lt;100 samples/year; single observation, limited sampling</i> )
<b>Benthos</b>		
sampling gear		collect by hand, sandbag, fine-mesh samplers made with net between PVC pipe joins, dipnet, kick net (1 meter); 200-400 micron mesh
habitat selection		multihabitat
subsample size		entire sample, aimed at >10 organisms/taxon (from qualitative field picking)
taxonomy		genus, species
<b>Fish</b>		
sampling gear		backpack electrofisher, boat electrofisher, seine; 1/8" mesh
habitat selection		multihabitat
sample processing		length measurement, anomalies
subsample		none
taxonomy		species, subspecies
<b>Periphyton</b>		
sampling gear		<b>natural substrate:</b> brushing/scraping device (razor, toothbrush, etc.), collect by hand; <b>artificial substrate:</b> collect by hand, bring rock back to lab
habitat selection		richest habitat
sample processing		taxonomic identification
taxonomy		diatoms only, species level
<b>Habitat assessments</b>		visual based, performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, taxonomic proficiency checks, specimen archival, certification program for bioassessment

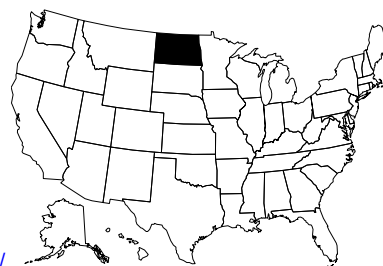
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index and return single metrics - use endpoint for each single metric</i> )
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		reference data set used to set bounds for metrics - percent will vary with metric
defining impairment in a multimetric index		reference data set used to set bounds for metrics - percent will vary with metric
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>seasonal, multiyear data</i> )
	<input checked="" type="checkbox"/>	precision ( <i>to look for subtle differences in water quality</i> )
	<input checked="" type="checkbox"/>	sensitivity ( <i>different teams sample the same site</i> )
	<input checked="" type="checkbox"/>	bias ( <i>overlap sites with different crews</i> )
	<input checked="" type="checkbox"/>	accuracy ( <i>compare bioassessments with chemical &amp; toxicity data</i> )
<b>Biological data</b>		
Storage		Fourth Dimension used for benthos data, MS Access used for fish and phytoplankton data
Retrieval and analysis		In house database

# NORTH DAKOTA

## Contact Information

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NDHD Division of Water Quality homepage: <http://www.health.state.nd.us/ndhd/envIRON/wq/>



## Program Description

The primary goal of North Dakota's biological monitoring and assessment program is to develop a set of scientifically defensible ecological indicators that can be used to assess the extent to which the state's rivers and streams are meeting their designated aquatic life uses. Once developed, these indicators can also be used to set restoration goals when developing total maximum daily loads (TMDLs) and/or Section 319 nonpoint source pollution project implementation plans.

The North Dakota Department of Health (NDHD) initiated its biological monitoring and assessment program in 1993 and 1994 as part of an interagency project to develop a multimetric index of biological integrity (IBI) for fish in the Lake Agassiz Plain ecoregion, Red River of the North Basin. In addition to the Department of Health, other agencies involved in the project were the Minnesota Pollution Control Agency, Minnesota Department of Natural Resources, EPA Region V, and the USGS – Red River National Water Quality Assessment (NAWQA) project team. The project resulted in a 12 metric IBI for fish which distinguished among headwater, moderate, and large sized rivers.

Since 1995, NDHD has conducted biological monitoring in each of the state's four major river basins. The Department's biological monitoring and assessment efforts continued in the Red River of the North Basin in 1995 and 1996. In addition to fish, the Department began sampling macroinvertebrates in 1995. In 1997 and 1998, monitoring and assessment efforts were expanded to the Souris River and James River basins, respectively, and in 1999 and 2000 the Department sampled the Missouri River Basin. In addition to fish and macroinvertebrate samples collected at each site, NDHD also conducted a habitat assessment following EPA's Rapid Bioassessment Protocol.

Preliminary multimetric IBIs have been developed for fish and macroinvertebrates in the Red River Basin and for fish in the Souris River Basin. These IBIs have been used to assess aquatic life use support for the 2000 Section 305(b) report. As these IBIs are refined and as additional IBIs are developed for the remaining river basins, it is the Department's intent to include these biological assessments in future Section 305(b) reports as well as in the development of Section 303(d) TMDL lists.

NDHD is currently collaborating with North Dakota State University and EPA Region VIII in a two year pilot project to evaluate the response of the benthic periphyton community to varying summer growing season nutrient levels with the goal of developing regional nutrient criteria. Based on the results of this pilot project, NDHD may include periphyton in future biological monitoring and assessment activities, especially in relation to nutrient enrichment and eutrophication.

The Department is also a collaborator with EPA in the EMAP Western Pilot Project. The EMAP Western Pilot is currently in the third year of a four year project. By collaborating in this 12 state project, the Department hopes to integrate EMAP sampling design as well as EMAP sampling protocols into future biological monitoring and assessment projects. When NDHD's commitment to this project is completed in 2004, it's the Department's plan to begin its rotating basin monitoring program with the Red River Basin.

## Documentation and Further Information

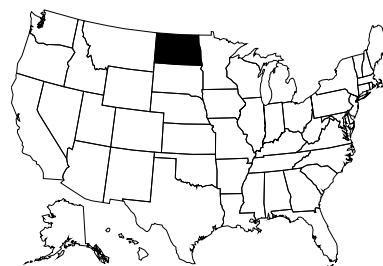
*North Dakota Water Quality Assessment 1998 - 1999, 2000 305(b) Report:*  
[http://www.health.state.nd.us/ndhd/envIRON/wq/2000\\_305b/2000\\_305b.pdf](http://www.health.state.nd.us/ndhd/envIRON/wq/2000_305b/2000_305b.pdf)

For links to numerous NDHD surface water quality/management publications, including *Standards of Quality for Waters of the State, Chapter 33-16-02* and *North Dakota Unified Watershed Assessment, FY1999*, go to:  
<http://www.health.state.nd.us/ndhd/envIRON/wq/>

# NORTH DAKOTA

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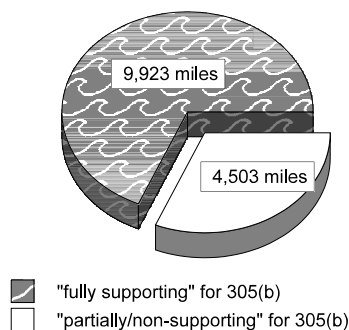
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
<b>Applicable monitoring designs</b>	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects only</i> )
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin ( <i>specific river basins or watersheds</i> )
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b>	<b>54,427</b>
<i>(determined using RF3)</i>	
Total perennial miles	unknown
<b>Total miles assessed for biology*</b>	<b>14,426</b>
fully supporting for 305(b)	9,923
partially/non-supporting for 305(b)	4,503
listed for 303(d)	—
number of sites sampled ( <i>on an annual basis</i> )**	150
number of miles assessed per site	—

## 14,426 Miles Assessed for Biology



\*Both stream and river miles were assessed for biological, chemical and physical effects. As reported in ND's 2000 305(b) report, approximately 68.8 percent (9,923 miles) of rivers and streams assessed for this report fully support the beneficial use designated as aquatic life. The remaining 31.2 percent of rivers and streams (4,503 miles) either partially supporting or did not support their aquatic life uses.

\*\*According to ND's 2000 305(b) report, "In 1997, 1998, and 1999, the department focused its intensive basin survey efforts on the Souris River Basin, the James River Basin, and the Lake Sakakawea subbasin, respectively. In addition to chemical monitoring, biological monitoring was conducted at approximately 50 sites in each basin each year."

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Single Aquatic Life Use	
<b>ALU designations in state water quality standards</b>	North Dakota has several classes described (Class I, Ia, II, and III) but the ALU is basically the same for all classes.	
<b>Narrative Biocriteria in WQS</b>	A narrative biological goal is contained in ND's water quality standards. There are no formal/informal numeric procedures used to support narrative biocriteria.	
<b>Numeric Biocriteria in WQS</b>	none	
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Nonpoint source project implementation plans	

## Reference Site/Condition Development

<b>Number of reference sites</b>	~75 total	
<b>Reference site determinations</b>	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Reference site criteria</b>	Reference sites are the best sites of the whole population sampled, determined by habitat condition of sites and fish IBI.	
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input checked="" type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
<b>Additional information</b>	<input checked="" type="checkbox"/>	other: river basin
	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos ( <i>100 - 500 samples/year; single season, multiple sites - watershed level</i> )
	<input checked="" type="checkbox"/>	fish ( <i>&lt;100 samples/year; single season, multiple sites - watershed level</i> )
	<input checked="" type="checkbox"/>	periphyton ( <i>&lt;100 samples/year; multiple seasons, multiple sites - broad coverage for watershed level</i> )
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		D-frame; 500-600 micron mesh
habitat selection		multihabitat
subsample size		300 count
taxonomy		lowest practical, usually genus
<b>Fish</b>		
sampling gear		boat and longline electrofishers, pram unit (tote barge)
habitat selection		multihabitat
sample processing		length measurement, biomass - batch, anomalies
subsample		none
taxonomy		species
<b>Periphyton</b>		
sampling gear		<b>natural substrate:</b> suction device
habitat selection		riffle/run (cobble)
sample processing		taxonomic identification
taxonomy		diatoms only
<b>Habitat assessments</b>		visual based and hydrogeomorphology; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan and specimen archival

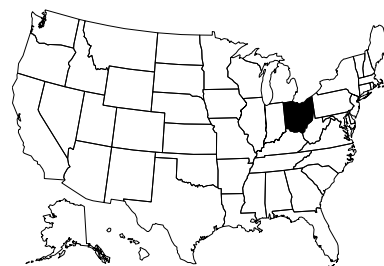
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>multimetric index under development</i> )
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		95 <sup>th</sup> percentile of all sites
defining impairment in a multimetric index		"power analysis"
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>replicate sampling within and among years</i> )
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		Fish and habitat assessment data are in an MS Access 97 database maintained by the Department. Macroinvertebrate data are in EDAS.
Retrieval and analysis		Macroinvertebrate data are analyzed by EDAS, and plots generated by SAS. Fish data are analyzed with queries developed in-house.

# OHIO

## Contact Information

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OHEPA Division of Surface Water, Statewide Biological and Water Quality Monitoring  
and Assessment homepage: <http://www.epa.state.oh.us/dsw/bioassess/ohstrat.html>



## Program Description

The Ohio EPA has been sampling biological communities in Ohio streams and rivers with standardized sampling protocols since the mid 1970s. Biological criteria was incorporated into the Ohio water quality standards (WQS; Ohio Administrative Code 3745-1) regulations in February 1990 (effective May 1990). These criteria consist of numeric values for the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), both of which are based on fish assemblage data, and the Invertebrate Community Index (ICI), which is based on macroinvertebrate assemblage data. Criteria for each index are specified for each of Ohio's five ecoregions (as described by Omernik 1987), and are further organized by organism group, index, site type, and aquatic life use designation. These criteria, along with the existing chemical and whole effluent toxicity evaluation methods and criteria, figure prominently in the monitoring and assessment of Ohio's surface water resources.

Ohio EPA employs biological, chemical, and physical monitoring and assessment techniques in biosurveys in order to meet three major objectives: 1) determine the extent to which use designations assigned in the Ohio WQS are either attained or not attained; 2) determine if use designations assigned to a given waterbody are appropriate and attainable; and 3) determine if any changes in key ambient biological, chemical, or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices. Biosurvey data are processed, evaluated, and synthesized in a biological and water quality report. Each biological and water quality study contains a summary of major findings and recommendations for revisions to WQS, future monitoring needs, or other actions that may be needed to resolve existing impairment of designated uses. While the principal focus of a biosurvey is on the status of aquatic life uses, the status of other uses such as recreation and water supply, as well as human health concerns, are also addressed.

## Documentation and Further Information

Year 2000 Ohio Water Resource Inventory, 305(b) Report: <http://www.epa.state.oh.us/dsw/documents/Ohio305B2000.pdf>

FWPCA Section 303(d) TMDL Priority List for FFY 1999-2000: <http://www.epa.state.oh.us/dsw/tmdl/303dnotc.html>

The State of the Aquatic Ecosystem: Ohio Rivers and Streams, 1998 Status:  
<http://www.epa.state.oh.us/dsw/documents/fs8mas98.pdf>

The Role of Biological Criteria in Water Quality Monitoring, Assessment, and Regulation, 1995:  
<http://www.epa.state.oh.us/dsw/documents/instbusl.pdf>

Using Biological Criteria to Validate Applications of Water Quality Criteria: Dissolved and Total Recoverable Metals, February 1997: [http://www.epa.state.oh.us/dsw/documents/gli\\_bio.pdf](http://www.epa.state.oh.us/dsw/documents/gli_bio.pdf)

Rankin, E.T. 1989. *The qualitative habitat evaluation index (QHEI): rationale, methods, and application*. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Biological and Water Quality Reports, list of documents: [http://www.epa.state.oh.us/dsw/document\\_index/psdindx.html](http://www.epa.state.oh.us/dsw/document_index/psdindx.html)

Biocriteria manuals are currently only available as hard copies upon emailed or written request. Information on obtaining copies can be found at [http://www.epa.state.oh.us/dsw/document\\_index/printdoc.html](http://www.epa.state.oh.us/dsw/document_index/printdoc.html). The biocriteria manuals are titled as follows:

Ohio Environmental Protection Agency. 1987a. *Biological criteria for the protection of aquatic life: Volume I. The role of biological data in water quality assessment*. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1987b. *Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters*. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

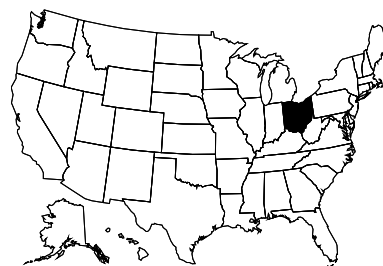
Ohio Environmental Protection Agency. 1989b. *Addendum to Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters*. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989c. *Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities*. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

# OHIO

## Contact Information

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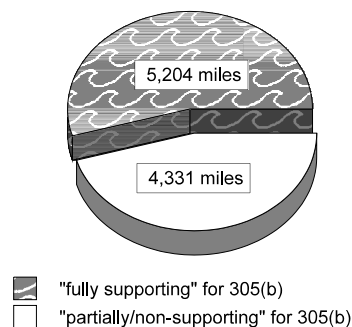
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALUS determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
<b>Applicable monitoring designs</b>	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects, specific river basins or watersheds, and comprehensive use throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) ( <i>specific river basins or watersheds</i> )
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin ( <i>special projects, specific river basins or watersheds, and comprehensive use throughout jurisdiction</i> )
	<input checked="" type="checkbox"/>	other: geometric design ( <i>specific river basins or watersheds and comprehensive use throughout jurisdiction</i> )

## Stream Miles

<b>Total miles</b>	<b>29,113</b>
<i>(based on the USEPA RF3 map of perennial stream miles as determined for Ohio)</i>	
Total perennial miles	29,113
<b>Total miles assessed for biology</b>	<b>9,535</b>
fully supporting for 305(b)	5,204
partially/non-supporting for 305(b)	4,331
listed for 303(d)*	2,052
number of sites sampled (1999-2000)	1,100
number of miles assessed per site (1999-2000)	2.5

## 9,535 Miles Assessed for Biology



\*The 2,052 miles are from Ohio's 1998 303(d) list, which is based on the 1996 305(b) statistics and includes data collected through 1994. OHEPA has recently taken a different approach to assessment and listing that will be reflected in upcoming 303(d) listings. The Agency now discourages the use of attainment statistics based on monitored stream miles in favor of a watershed level approach that provides an indication of the attainment status of watersheds in total (in essence, a measure of square miles of watersheds fully, partially, or not supporting ALU).

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Class System (A,B,C) - Tiered
<b>ALU designations in state water quality standards</b>	Seven designations: Warmwater Habitat, Exceptional Warmwater Habitat, Coldwater Habitat, Modified Warmwater Habitat, Seasonal Salmonid, Limited Warmwater Habitat (being phased out), Limited Resource Water
<b>Narrative Biocriteria in WQS</b>	Procedures used to support narrative biocriteria located in Ohio WQS, <a href="http://www.epa.state.oh.us/dsw/rules/3745-1.html">http://www.epa.state.oh.us/dsw/rules/3745-1.html</a>
<b>Numeric Biocriteria in WQS</b>	Also found in Ohio WQS, see above link
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation) <input checked="" type="checkbox"/> watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	There are many instances where bioassessments documented before and after conditions based on POTW improvements. Biosurvey data and biocriteria thresholds are the primary arbiters in the determination of aquatic life use attainment status; results are used to determine 305(b) aquatic life use attainment statistics and to drive the 303(d) listing/delisting and TMDL development process.

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>500 total</b> (including modified reference sites)
<b>Reference site determinations</b>	<input type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Reference site criteria*</b>	Representative of best watershed conditions within an ecoregion given the background activities prevalent in society.
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input type="checkbox"/> gradient response <input type="checkbox"/> professional judgment <input type="checkbox"/> other:
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input type="checkbox"/> stream type <input type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input type="checkbox"/> other:
<b>Additional information</b>	<input checked="" type="checkbox"/> reference sites linked to ALU <input checked="" type="checkbox"/> reference sites/condition referenced in water quality standards ( <i>listed in Biocriteria Manuals, which are referenced in WQS</i> ) <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

\*All reference sites were originally screened to eliminate sites with evidence of substantial human disturbance. This was accomplished by examining maps of human population density and current and past land uses, compiling a watershed disturbance ranking, and noting the size and location of point source discharges. Additional site-specific factors considered in the selection of a reference site included (1) the amount, if any, of stream channel modification, (2) the condition of the vegetative riparian buffer zone, (3) water volume, (4) channel morphology characteristics, (5) substrate character and condition, (6) presence of obvious color/odor problems, (7) amount of instream woody debris, and (8) the general representativeness of the site within the ecoregion.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (100-500 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	fish (100-500 samples/year; single season, multiple sites - broad coverage)
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		collect by hand, multiplate: 200-400 micron mesh
habitat selection		multihabitat and artificial substrate
subsample size		entire sample (presort with subsampling)
taxonomy		combination (lowest practical with current knowledge)
<b>Fish</b>		
sampling gear		backpack electrofisher (in small streams only), boat electrofisher, pram unit (tote barge), and longline method using electrofishing unit and 100 meter line
habitat selection		multihabitat
sample processing		biomass - individual and batch, anomalies
subsample		batch (for weight only)
taxonomy		species
<b>Habitat assessments</b>		visual based; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, taxonomic proficiency checks, specimen archival, and a certification program for bioassessment has been developed for the OHEPA Voluntary Action Program (i.e., Brownfields Redevelopment)

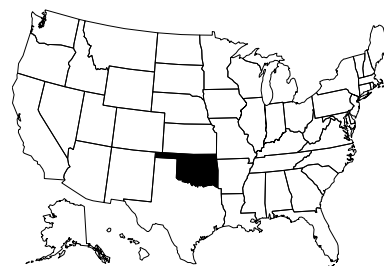
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		95 <sup>th</sup> percentile of reference population
defining impairment in a multimetric index		25 <sup>th</sup> percentile of reference population (ecoregion Warmwater Habitat and Modified Warmwater Habitat); 75 <sup>th</sup> percentile of reference population (statewide Exceptional Warmwater Habitat); EPA RBP Guidelines
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>many sites - including reference sites - with multiple-year collections to track temporal variability</i> )
	<input checked="" type="checkbox"/>	precision ( <i>multiple samples occasionally collected from the same site on the same date, especially at potential litigation sites</i> )
	<input checked="" type="checkbox"/>	sensitivity ( <i>studies have been done to determine the possible range of variation in index scores at a given sampling location on a given sampling date</i> )
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		In initial stages of modernization and migration to MS Access
Retrieval and analysis		Custom programs to calculate indices, other summarized data, 305(b) statistics, etc.

# OKLAHOMA

## Contact Information

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## Program Description

The Oklahoma Water Resources Board (OWRB) has many monitoring programs. In 1998, the State Legislature directed the OWRB to oversee certain state water quality monitoring activities to determine compliance with Oklahoma's Water Quality Standards (OWQS). Specifically, the OWRB was charged with coordinating all monitoring under a standing cooperative agreement with the USGS, conducting a Comprehensive Beneficial Use Monitoring Program (BUMP), and developing Use Support Assessment Protocols (USAPS) to ensure the consistent data interpretation of beneficial use support. The overall goal of BUMP is to document beneficial use impairments, identify impairment sources (if possible), detect water quality trends, provide needed information for the OWQS and facilitate the prioritization of pollution control activities. River and stream monitoring is one of five key elements of BUMP.

So far, OWRB's biological monitoring is related only to special projects, such as biocriteria development or the occasional fish tissue study. However, BUMP is a developing program and there is intent to expand biological monitoring in the near future. Presently, there are fixed and rotating stations at which chemistry and flow information may be collected. The OWRB is currently monitoring almost 200 sites on a monthly basis. These sites are segregated into two discrete types of monitoring activities. The first monitoring activity is focuses on fixed station monitoring on rivers and streams. In general, at least one sample station is located in each of 67 watersheds. Following consultation with other appropriate state environmental agencies, the OWRB originally identified 84 fixed sites; that number has now grown to 100. The second component of river and stream monitoring focuses on water quality sampling stations whose location will rotate on an annual basis. Stations and identified monitoring parameters were based upon Oklahoma's 303(d) list and the monitoring requirements of other state environmental agencies. Monitoring parameters are specific for each stream segment.

Oklahoma DEQ's fish monitoring program has been discontinued but provided a wealth of information concerning statewide fish distribution. Improvements in Oklahoma's water quality monitoring programs are being developed and implemented in order to provide more consistent and reliable information related to the condition of aquatic resources (including quality habitat alteration, and impacts of polluted runoff and point source discharges). Unfortunately, much of the monitoring information in Oklahoma is fragmentary and incompatible because it is collected through programs that are designed and conducted for differing objectives.

## Documentation and Further Information

*The State of Oklahoma Water Quality Assessment Report, 2000 Edition, November 2000:*  
[http://www.deq.state.ok.us/WQDnew/305b\\_303d/2000\\_305b\\_Report\\_Final.pdf](http://www.deq.state.ok.us/WQDnew/305b_303d/2000_305b_Report_Final.pdf)

*Status of Water Quality Monitoring in Oklahoma, 2000 Final Report to the Oklahoma Legislature:*  
[www.owrb.state.ok.us/reports/OkWqStatus2000.pdf](http://www.owrb.state.ok.us/reports/OkWqStatus2000.pdf)

*Oklahoma Water Resources Board, Chapter 46 of Implementation of Oklahoma's WQS, effective August 2001:*  
<http://www.owrb.state.ok.us/rules/Chap46.pdf>

*SOP for Field Sampling Efforts of the OK Water Resources Board Beneficial Use Monitoring Program, June 2001:*  
[http://www.owrb.state.ok.us/reports/BUMP\\_SOPFY-01.pdf](http://www.owrb.state.ok.us/reports/BUMP_SOPFY-01.pdf)

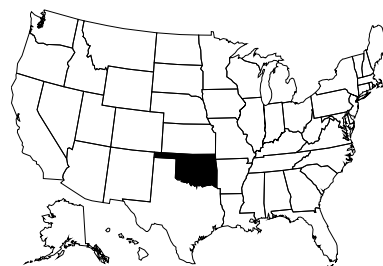
*Oklahoma's Nonpoint Source Management Program and Nonpoint Source Assessment Report, FINAL DRAFT:*  
[http://www.okcc.state.ok.us/Divisions/Water\\_Quality/Reports/REPORT078.pdf](http://www.okcc.state.ok.us/Divisions/Water_Quality/Reports/REPORT078.pdf)

Conduct your own "Biological Monitoring" search for additional documents using: <http://www.soonersearch.odl.state.ok.us/>

# OKLAHOMA

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## Programmatic Elements

<b>Uses of bioassessment within overall water quality program*</b>	<input type="checkbox"/>	problem identification (screening)
	<input type="checkbox"/>	nonpoint source assessments
	<input type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
<b>Applicable monitoring designs</b>	<input type="checkbox"/>	targeted (i.e., sites selected for specific purpose)
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	rotating basin
	<input type="checkbox"/>	other:

\*Several possibilities exist, but currently only use-support decisions and use assignments are done with bioassessments.

## Stream Miles

<b>Total miles</b>	<b>78,778</b>
<i>(State based determination - waterbody identifications)</i>	
Total perennial miles	22,386
<b>Total miles assessed for biology</b>	<b>13,313</b>
fully supporting for 305(b)**	—
partially/non-supporting for 305(b)**	—
listed for 303(d)**	—
number of sites sampled	3,391
number of miles assessed per site	~4 (site specific)

\*\*Much of Oklahoma's efforts are still in the development stages. The new 305(b) and 303(d) are not complete and there have been significant changes in protocol since last completed; thus the data from past reports are no longer relevant. The new 305(b) and 303(d) reports should be complete sometime in 2002.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	ALU subcategories	
<b>ALU designations in state water quality standards</b>	Habitat Limited Aquatic Community (least restrictive), Warm Water A.C., Cool Water A.C. (most restrictive), Trout Fishery (anti-degradation limitation)	
<b>Narrative Biocriteria in WQS</b>	Formal/informal numeric procedures used to support narrative biocriteria exist for specific ecoregions only.	
<b>Numeric Biocriteria in WQS</b>	Only for specific ecoregions; biological use-support thresholds found in 785:46-15 (WQS implementation).	
<b>Uses of bioassessment data in integrated assessments with other environmental data</b> (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	none	

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>66 - 132 total</b> (will increase as number of ecoregions are completed)	
<b>Reference site determinations</b>	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: least impacted, no point sources
<b>Reference site criteria</b>	Reference sites are defined by the least impacted version of a stream type in a particular ecoregion. Specific criteria is under development.	
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input checked="" type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
<b>Additional information</b>	<input checked="" type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (<100 samples/year; single observation, limited sampling)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; single observation, limited sampling)
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
<b>Benthos</b>		
sampling gear		dipnet, kick net (1 meter); 500-600 micron mesh
habitat selection		riffle/run (cobble) and woody debris
subsample size		100 count
taxonomy		genus
<b>Fish</b>		
sampling gear		backpack electrofisher, seine; 1/4" mesh
habitat selection		all habitats contained within the "representative" reach of 200 - 400 meters
sample processing		anomalies and taxonomic identification
subsample		none
taxonomy		species
<b>Habitat assessments</b>		quantitative measurements; performed independent of bioassessments (see <i>Oklahoma Water Resource Board Technical Report 99-3</i> for more information)
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan, taxonomic proficiency checks and specimen archival

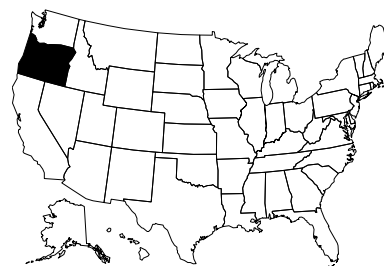
## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		cumulative distribution function (ecoregion dependent)
defining impairment in a multimetric index		cumulative distribution function (ecoregion dependent)
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>site validation collections and habitat assessments</i> )
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		MS Access and/or Excel formats
Retrieval and analysis		application dependent, spreadsheet driven (no large statistical treatment yet); in the process of pulling existing data from other agencies to help develop a program

# OREGON

## Contact Information

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ORDEQ Water Quality Program homepage: <http://www.deq.state.or.us/wq/>



## Program Description

Oregon DEQ (ORDEQ) has a history of using biological data in water quality assessments. Since the early 1990's the biomonitoring program has grown from two full time staff to nine current permanent staff, and over 15 during the summer field season. The principle objectives of the biomonitoring program are to:

- Assess the status of stream conditions and fish and macroinvertebrate assemblages across the state,
- Identify trends in stream conditions and biological assemblages,
- Identify the primary chemical and physical parameters impairing biological assemblages,
- Assess the effectiveness of restoration projects and management activities designed to improve stream conditions, and
- Help standardize protocols for biological assessments throughout the state and region

Increased concern over nonpoint sources of pollution and the listing of numerous salmon species as threatened or endangered has focused more attention on the importance of biological information in the State. In 1991 Oregon DEQ adopted narrative biocriteria into state water quality standards. ORDEQ is currently developing numeric biocriteria and expects to have numeric standards adopted by 2004.

Most biological data are collected using a probabilistic sampling design. A reference site network is also being developed and sampled. ORDEQ has worked closely with EPA and other state agencies in developing its monitoring strategy. Over 400 sites have been sampled for biological, chemical and physical parameters (approximately 150 sites per year). Currently biological data are incorporated into the State's 305(b) report and 303(d) list. Other biological data are used in NPDES permit assessments, CWA Section 401 permit applications, and beneficial use assessments.

Maintaining a commitment to long-term funding is one of the primary challenges of any state monitoring effort. Data management and data quality are also key issues that require ongoing efforts to maintain an effective program. Finally, integrating biological data into the overall water quality program (i.e. TMDLs) is an ongoing challenge and an area for improvement in the future. To view current ORDEQ biomonitoring technical reports, go to: [http://www.deq.state.or.us/lab/Biomon/bio\\_rpt.htm](http://www.deq.state.or.us/lab/Biomon/bio_rpt.htm)

## Documentation and Further Information

*Oregon's 2000 Water Quality Status Assessment Report, Section 305(b) Report:*  
<http://www.deq.state.or.us/wq/305bRpt/305bReport00a.pdf>

ORDEQ Water Quality Limited Streams 303(d) List information (including Listing Criteria, etc.):  
<http://www.deq.state.or.us/wq/303dlist/303dpage.htm>

Oregon Water Quality Standards homepage: <http://www.deq.state.or.us/wq/standards/wqstdshome.htm>

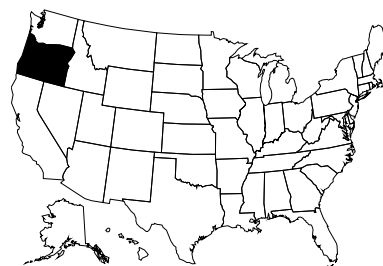
*Quality Assurance Guidelines:*  
<http://www.deq.state.or.us/lab/qa/NPDES%20and%20WPCF%20Self-Monitoring%20Laboratories.pdf>

Mrazik, S. 1999. *Reference site selection: a six step approach for selecting reference sites for biomonitoring and stream evaluation studies*. Oregon Department of Environmental Quality, Biomonitoring Section.

# OREGON

## Contact Information

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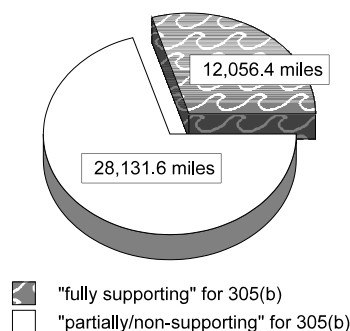
## Programmatic Elements

<b>Uses of bioassessment within overall water quality program</b>	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input checked="" type="checkbox"/>	other: 401 permits and restoration effectiveness monitoring
<b>Applicable monitoring designs</b>	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) ( <i>special projects only</i> )
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input checked="" type="checkbox"/>	probabilistic by stream order/catchment area ( <i>specific river basins or watersheds</i> )
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide ( <i>comprehensive use throughout jurisdiction</i> )
	<input type="checkbox"/>	rotating basin
	<input type="checkbox"/>	other:

## Stream Miles

<b>Total miles</b>	<b>114,823</b>
<i>(determined using RF3 and National Hydrography Database)</i>	
Total perennial miles	51,695
<b>Total miles assessed for biology*</b>	<b>40,188</b>
fully supporting for 305(b)	12,056.4
partially/non-supporting for 305(b)	28,131.6
listed for 303(d)**	unknown
number of sites sampled ( <i>on an annual basis</i> )***	150+
number of miles assessed per site	—

## 40,188 Miles Assessed for Biology



\*Most of the biological monitoring is based on a probabilistic sampling design in order to calculate the total stream miles represented by the data.

\*\*ORDEQ is in the process of drafting a new 303(d) list (as of March 2002). If ORDEQ were to provide data based on past 303(d) lists, the number of miles listed would be considerably smaller than the 28,131 miles that are "partially/non-supporting" for 305(b) because 303(d) lists are *not* based on a probabilistic sampling design.

\*\*\*Over 400 total sites have been sampled.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Fishery Based Uses
<b>ALU designations in state water quality standards</b>	Four designations: Salmonid Passage; Salmonid rearing; Salmonid spawning; Protection of resident fish and aquatic life
<b>Narrative Biocriteria in WQS</b>	applied using a numeric approach found in 303(d) listing criteria, <a href="http://www.deq.state.or.us/wq/303dlist/303dpage.htm">http://www.deq.state.or.us/wq/303dlist/303dpage.htm</a>
<b>Numeric Biocriteria in WQS</b>	under development
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/> assessment of aquatic resources
	<input checked="" type="checkbox"/> cause and effect determinations
	<input checked="" type="checkbox"/> permitted discharges
	<input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation)
	<input type="checkbox"/> watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	The best example is a stream restoration project in Eastern Oregon that is trying to restore habitat and water quality to support salmonid spawning and rearing. Bioassessment data have been an ongoing part of this project's evaluation.

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>200 total</b>
<b>Reference site determinations</b>	<input type="checkbox"/> site-specific
	<input type="checkbox"/> paired watersheds
	<input checked="" type="checkbox"/> regional (aggregate of sites)
	<input checked="" type="checkbox"/> professional judgment
	<input checked="" type="checkbox"/> other: see criteria below
<b>Reference site criteria</b>	Reference sites must fall into the lowest level of human disturbance based on a set of GIS information and field results including land use, road density and habitat (GIS data and best professional judgment are used to identify 5 <sup>th</sup> field watersheds with minimal human disturbance). Once potential watersheds have been identified, stream monitoring sites are randomly selected from within those watersheds. Field reconnaissance confirms if they are suitable reference sites.
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/> historical conditions
	<input checked="" type="checkbox"/> least disturbed sites
	<input type="checkbox"/> gradient response
	<input type="checkbox"/> professional judgment
	<input checked="" type="checkbox"/> other: minimally disturbed*
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/> ecoregions (or some aggregate)
	<input checked="" type="checkbox"/> elevation
	<input checked="" type="checkbox"/> stream type
	<input checked="" type="checkbox"/> multivariate grouping
	<input type="checkbox"/> jurisdictional (i.e., statewide)
	<input checked="" type="checkbox"/> other: gradient; latitude and longitude; conductivity; watershed area
<b>Additional information</b>	<input type="checkbox"/> reference sites linked to ALU
	<input checked="" type="checkbox"/> reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

\*Oregon has three classes of reference sites: A - Sites with no human disturbance. These sites represent "natural" conditions and are generally found in wilderness areas or very remote regions of the state, B - Sites with minimal human disturbance. These sites represent conditions expected to occur without or with very minimal human activity, and C - Sites with human disturbance that measurably alters stream conditions. These are the best available (least disturbed) sites.

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (100-500 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	fish (100-500 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	periphyton (<100 samples/year; single season, multiple sites - watershed level) <i>NOTE: ORDEQ samples periphyton for some projects, but not at the majority of sites.</i>
	<input checked="" type="checkbox"/>	other: amphibians and reptiles (100-500 samples/year; single season, multiple sites - broad coverage)
<b>Benthos</b>		
sampling gear		D-frame; 500-600 micron mesh
habitat selection		riffle/run (cobble)
subsample size		500 count
taxonomy		combination - typically genus/species. A regional (multistate) taxonomy workgroup meets to set taxonomic level standards.
<b>Fish/Amphibians</b>		
sampling gear		backpack electrofisher
habitat selection		multihabitat
sample processing		length measurement and anomalies
subsample		none
taxonomy		species
<b>Periphyton</b>		
sampling gear		<b>natural substrate:</b> brushing/scraping device (razor/toothbrush, etc.)
habitat selection		riffle/run (cobble)
sample processing		taxonomic identification
taxonomy		all algae
<b>Habitat assessments</b>		quantitative measurements; performed with bioassessments
<b>Quality assurance program elements</b>		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, and specimen archival

## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<b>Multimetric thresholds</b>		
transforming metrics into unitless scores		25 <sup>th</sup> percentile of reference population
defining impairment in a multimetric index		Cumulative distribution function
<b>Multivariate thresholds</b>		
defining impairment in a multivariate index		Significant departure from mean of reference population
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>a minimum of 10% of sites are sampled twice each field season</i> )
	<input checked="" type="checkbox"/>	precision ( <i>Signal-to-noise analysis</i> )
	<input checked="" type="checkbox"/>	sensitivity ( <i>Multivariate model sensitivity checked by rerunning model on subset of reference sites</i> )
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<b>Biological data</b>		
Storage		Data are stored in an agency database using MS Access. Macroinvertebrate data are also being stored in a regional database (multi-agency and multi-state).
Retrieval and analysis		SAS and Statistica